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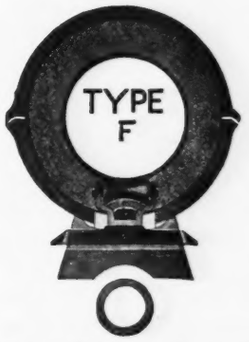


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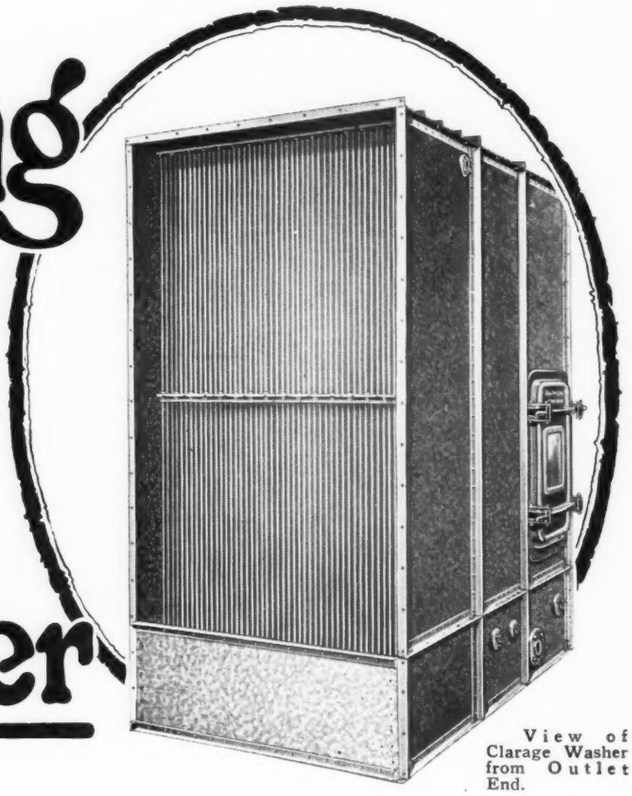

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# Practical Notes on the Use of Pressure Regulators and Pressure-Reducing Valves

## Common Errors to Avoid in the Application of These Devices, Based Upon a Large Experience in the Field

*By T. H. Ireland**

IT IS self-evident that many pressure regulators and pressure-reducing valves have been applied on a hit-or-miss basis which have proven unsatisfactory to both the manufacturer and the user; the valve has been condemned and the user has had extensive repairs and unsatisfactory regulation of the service pressure.

In steam plants which have applied pressure regulators based on the following information, excellent results have been obtained with a uniform regulation of the service pressure, and the maintenance expense has been reduced to almost nothing. There are many steam systems where such pressure regulators have been in constant service for several years without any attention since they were installed and adjusted for the service pressure.

### HOW TO SELECT PRESSURE REGULATORS FOR STEAM SERVICE

"To determine the proper relation between the size of the regulator and the service, or low-pressure, piping, see Tables 1, 2 and 3. The velocity of steam through the initial and service lines in these tables is figured approximately the same. For example, it is desired to reduce 1000 lbs. of steam per hour from 100 lbs. boiler pressure to 30 lbs. service pressure, to find, first, what size regulator is required and, second, what size piping is necessary on the 30-lb. line.

"Refer to Table 2. At 100 lbs. initial pressure, a 2-in. valve will handle 1025 lbs. of steam per hour. This is the size nearest to the requirement. Refer to Table 2. Follow the 100-lb. initial-pressure column down until opposite 30 lbs. service pressure, in the left-hand column, will be found 2.4. This shows that the service piping should have 2.4 times the area of the initial piping. For areas of circles, see tables in any handbook. Table 3 gives the proportional relation between the size of the regulator and the service piping.

"In the example mentioned, refer to Table 3, and follow the column under 2 in. until you find the figure reading nearest to 2.4. In this case you have 2.2 and 2.9. Follow 2.2 to the left, which calls for a 3-in. service pipe. Follow 2.9 to the left, which calls for a 3½-in. service pipe. If the service pipe is short, use a 3-in. If it is long or has many turns, use a 3½-in. pipe. Reverse this procedure to determine the proper size regulator, providing the service pipe is correct."

### APPLICATION OF PRESSURE REGULATORS

Next in importance to the selection of the proper type and size of a pressure regulator to handle a certain condition is its application. A pressure regulator is

TABLE 1—CAPACITY OF PRESSURE REGULATORS

IN POUNDS OF STEAM PER HOUR AT VARIOUS INITIAL PRESSURES

| | INITIAL STEAM PRESSURES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pounds | 50 | 60 | 70 | 80 | 90 | 100 | 125 | 150 | 175 | 200 | 250 |
| Size of Regulator | CAPACITY OF REGULATOR POUNDS OF STEAM PER HOUR | | | | | | | | | | |
| ½ | 25 | 28 | 32 | 37 | 40 | 43 | 51 | 60 | 68 | 77 | 90 |
| ¾ | 55 | 65 | 72 | 80 | 90 | 95 | 115 | 135 | 155 | 175 | 230 |
| 1 | 100 | 110 | 125 | 145 | 160 | 175 | 210 | 250 | 275 | 330 | 370 |
| 1¼ | 195 | 220 | 250 | 280 | 305 | 330 | 400 | 465 | 530 | 600 | 720 |
| 1½ | 280 | 320 | 360 | 400 | 440 | 480 | 575 | 670 | 770 | 870 | 1000 |
| 2 | 600 | 685 | 770 | 850 | 940 | 1025 | 1250 | 1450 | 1660 | 1870 | 2200 |
| 2½ | 940 | 1070 | 1200 | 1360 | 1480 | 1630 | 1950 | 2250 | 2600 | 2300 | 3400 |
| 3 | 1580 | 1800 | 2000 | 2200 | 2420 | 2700 | 3250 | 3800 | 4300 | 4900 | 5800 |
| 3½ | 2050 | 2350 | 2700 | 3000 | 3200 | 3500 | 4200 | 4900 | 5600 | 6300 | 8000 |
| 4 | 2800 | 3200 | 3600 | 3950 | 4350 | 4750 | 5750 | 6700 | 7600 | 8600 | 10000 |
| 5 | 5000 | 5700 | 6400 | 7150 | 7850 | 8500 | 10300 | 12000 | 13800 | 15500 | 18000 |
| 6 | 7200 | 8200 | 9200 | 10200 | 11300 | 12400 | 14800 | 17300 | 20000 | 22000 | 27000 |
| 8 | 12800 | 14600 | 16500 | 18300 | 20000 | 22000 | 26000 | 31000 | 35000 | 39000 | 47000 |

* New York Specialty Depts. Div., Crane Company.

applied to a steam system because certain appliances are not intended to be subjected to the initial pressure, yet in many plants no means have been provided to prevent such appliances from being subjected to the initial pressure, which may be caused by solid objects entering the pressure regulator in such a manner as to prevent it from functioning properly. The writer once found a 14-in. pinch bar between the seat and disc of one regulator, and in another found the part of a cast-iron pipe bushing. It is not an unusual thing to find a piece of wood, a bolt or other solid material in a pressure regulator.

The pressure regulator is expected to give better service than would be given by an individual, and when it is properly applied it will give the desired service.

It has been found in practice that two pressure regulators are better than one of equal capacity, for large heating systems used for heating buildings. A heating system when properly designed and assembled is arranged to meet the peak load demands, and in mild climates the peak load is in service less than 10% of the entire heating period, and frequently the system is operated with less than 25% of the heating system in service.

If a pressure regulator equal to the pipe size of the peak load is applied, it means that throughout the greater

## Distinguishing Characteristics of Pressure Regulators and Pressure-Reducing Valves

In considering the automatic reduction of steam pressure by means of pressure regulators and pressure-reducing vales, it is important to bear in mind the principle on which these appliances operate. This principle, of course, is differential in pressures which actuates the main valve that controls the flow of steam into the service pressure. The initial pressure enters the regulator and will not flow through the valve until the disc or closing device has been moved from the main valve port by the compression of a spring or a weight.

After the main valve has been opened the steam flows into the service pipe which has a connection to a diaphragm or piston, and as the steam pressure accumulates in the service portion of the regulator, it comes in contact with an enlarged area, or against one end of a piston that has its opposite end exposed to the atmosphere. Then the diaphragm, or the exposed piston, operates similar to the piston head of a reciprocating engine.

The compressed spring or weight is mechanically arranged so that with the aid of the service pressure it will exert a greater pressure than the initial pressure on the valve disc of the single-seated type of valves; with a double-seated type of valve, the weight or spring, with the aid of the service pressure, is arranged to close a balanced valve.

When a regulator is in service it is in a continuous reciprocating motion; this motion varies in different types of regulators. In practice the boiler pressure is known as the initial pressure, and the reduced pressure is known as the service pressure.

The pressure regulator is a valve which will reduce the pressure and maintain this reduction whether a large or small quantity of steam is consumed on the service side. The service pressure is not changed by a reasonable fluctuation of the service pressure. The service pressure will not build up to the initial pressure, as the regulator will shut off if no steam is being used.

The pressure-reducing valve, on the other hand, is a valve which will reduce the pressure and may not always maintain this reduction, whether a large or small quantity of steam is used on the service side. The service pressure is changed by the fluctuation of the initial pressure. It is possible that the service pressure will accumulate until it equals the initial pressure, as the reducing valve will not shut off tight if no steam is being used.

The following is intended to describe more fully the difference in the action of the pressure regulator and pressure-reducing valve. The illustration shows the relation of the pressure regulator to the initial and service pressures, showing only the operation of the regulator. It is not intended to show the proper application of either a regulator or reducing valve for reliable service. There is a globe valve connected to the initial-pressure service between the steam main and the regulator. A pressure gauge is connected to the service-pressure pipe a short distance from the regulator.

A pressure regulator is represented to supply steam to heat 10,000 sq. ft. of cast-iron radiation in a building that is heated between the hours of 7 A.M. and 6 P.M. during the heating season. At 7 A.M. the outside temperature is 0° F. All of the radiator valves are fully opened and at 7 A.M. the attendant opens the globe valve, permitting the steam to flow into the initial-pressure portion of the regulator; the regulator is adjusted to maintain 2 lbs. service pressure.

Then the attendant departs to attend to other duties and does not return to the regulator until 6 P.M., when he closes the globe valve and does not change the regulator adjustment. At 4 P.M. of the same day the outside temperature has increased to 60° F., and all but one of the radiator steam inlet valves have been closed. A reliable pressure regulator, operating under these conditions, should continue to maintain only 2 lbs. gauge on the piping system and the one radiator.

A pressure-reducing valve, having double-seated valves and connected in place of the regulator, would immediately have increased the pressure until the cast-iron radiator was subjected to nearly the initial pressure of 150 lbs. gauge. Cast-iron radiators are recommended for a maximum steam pressure of 25 lbs.

The gate valve indicated, connected to the service pipe, represents a method of determining the condition of a pressure regulator.

Assuming that the pressure regulator is operating with the above-mentioned heating system and maintained a constant service pressure of 2 lbs. gauge, and that the attendant closed the gate valve on the service-pressure side, instead of the globe valve on the initial-pressure side. If it is a good type of regulator and in proper condition, the service-pressure gauge should not show any increase in pressure, but continue to maintain the same constant service pressure that it did before the gate valve was closed. If the service-pressure gauge shows a rapid increase of pressure, it would indicate that the pressure regulator is leaking and if given immediate attention, may save costly repairs.

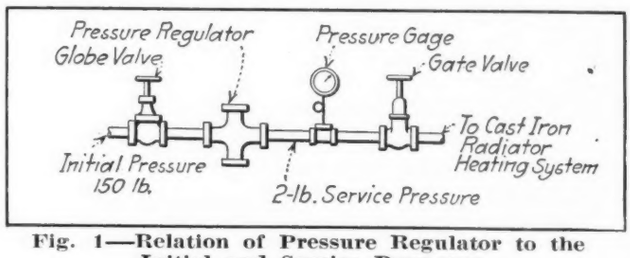


**Fig. 1—Relation of Pressure Regulator to the Initial and Service Pressures.**

A pressure-reducing valve, with double-seated valves, should not be used for industrial plant service, such as is required for supplying steam to laundry machines, kitchen appliances, jacketed kettles, sterilizing apparatus, or any other machine that is not designed to withstand the initial pressure.

There are concerns manufacturing both pressure regulators and pressure-reducing valves which emphasize, in their printed matter, the importance of applying pressure regulators, instead of pressure-reducing valves, where accurate control of the service pressure is required.

TABLE 2—RATIO OF DENSITY OR VOLUME INITIAL PRESSURE (SATURATED STEAM) TO SERVICE

| Service Pressures Pounds | BOILER OR HIGH INITIAL PRESSURES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 60 | 70 | 80 | 90 | 100 | 125 | 150 | 175 | 200 | 250 |
| | PROPORTIONAL RATIO | | | | | | | | | | |
| 1 | 3.8 | 4.3 | 4.9 | 5.5 | 6.0 | 6.5 | 7 9 | 9.2 | 10.0 | 11.7 | 14.4 |
| 2 | 3 6 | 4 1 | 4.6 | 5.1 | 5.6 | 6.1 | 7 3 | 8.5 | 9.8 | 10.9 | 13.4 |
| 3 | 3 3 | 3 9 | 4.3 | 4.8 | 5.3 | 5.8 | 6.9 | 8.0 | 9.2 | 10.4 | 12.7 |
| 5 | 3 1 | 3 5 | 4 0 | 4.4 | 4.8 | 5.3 | 6.3 | 7 4 | 8.5 | 9.5 | 11.6 |
| 10 | 2 5 | 2 8 | 3 2 | 3 5 | 3 9 | 4.2 | 5 1 | 5.9 | 6.8 | 7.6 | 9.3 |
| 15 | 2.1 | 2.4 | 2 7 | 3.0 | 3 3 | 3 6 | 4.3 | 5.0 | 5 7 | 6.4 | 7.8 |
| 20 | 1 8 | 2 0 | 2.3 | 2 5 | 2.8 | 3.0 | 3.7 | 4 3 | 4.9 | 5.5 | 6.7 |
| 25 | 1 6 | 1 8 | 2.0 | 2 3 | 2 5 | 2 7 | 3.3 | 3.8 | 4.4 | 4 9 | 6.0 |
| 30 | 1.5 | 1 6 | 1 8 | 2.0 | 2.2 | 2.4 | 2.9 | 3.4 | 3.9 | 4.4 | 5.4 |
| 35 | 1.3 | 1 5 | 1.6 | 1.8 | 2 0 | 2.2 | 2.6 | 3 1 | 3.5 | 3.9 | 4.8 |
| 40 | | 1 3 | 1 5 | 1 7 | 1.8 | 2 0 | 2.4 | 2.8 | 3 2 | 3 6 | 4.4 |
| 45 | | | 1 4 | 1.5 | 1 7 | 1 8 | 2.2 | 2 6 | 3.0 | 3.3 | 4.0 |
| 50 | | | 1 3 | 1 4 | 1 6 | 1 7 | 2 0 | 2.4 | 2 7 | 3 1 | 3 7 |
| 60 | | | | 1.2 | 1 4 | 1 5 | 1 8 | 2 1 | 2.4 | 2 7 | 3 2 |
| 70 | | | | | | 1 3 | 1.6 | 1 8 | 2 1 | 2 4 | 2 9 |
| 80 | | | | | | | 1 4 | 1 7 | 1.9 | 2.1 | 2 6 |
| 90 | | | | | | | 1 3 | 1 5 | 1 7 | 1 9 | 2.4 |
| 100 | | | | | | | | 1 4 | 1 6 | 1 8 | 2 2 |
| 110 | | | | | | | | 1 3 | 1 5 | 1 7 | 2.0 |
| 120 | | | | | | | | | 1 4 | 1 5 | 1 9 |
| 130 | | | | | | | | | 1 3 | 1 4 | 1 8 |
| 140 | | | | | | | | | | 1 3 | 1 6 |
| 150 | | | | | | | | | | | 1.5 |

TABLE 3—COMPARATIVE AREA OF REGULATOR TO SERVICE PIPING

STEAM SERVICE

| Size of Service Pipe Inches | INITIAL PIPE SIZE OR REGULATOR SIZE | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ½ | ¾ | 1 | 1¼ | 1½ | 2 | 2½ | 3 | 3½ | 4 | 5 | 6 | 8 |
| ¾ | 1 7 | 1 | | | | | | | | | | | |
| 1 | 2 8 | 1 6 | 1 | | | | | | | | | | |
| 1¼ | 4 9 | 2 8 | 1 7 | 1 | | | | | | | | | |
| 1½ | 6 7 | 3 8 | 2.4 | 1 4 | 1 | | | | | | | | |
| 2 | 11 0 | 6 3 | 3 9 | 2.2 | 1 6 | 1 | | | | | | | |
| 2½ | 15 7 | 9 0 | 5 5 | 3.2 | 2 3 | 1 4 | 1 | | | | | | |
| 3 | | 13 8 | 8 6 | 5.0 | 3 6 | 2 2 | 1 5 | 1 | | | | | |
| 3½ | | | 11.4 | 6.6 | 4 8 | 2 9 | 2 1 | 1 3 | 1 | | | | |
| 4 | | | 14.8 | 8 5 | 6 2 | 3.8 | 2 7 | 1 7 | 1 3 | 1 | | | |
| 5 | | | | 13 4 | 9 8 | 6 0 | 4 1 | 2 7 | 2 0 | 1 6 | 1 | | |
| 6 | | | | | 14 2 | 8 6 | 6 0 | 3 9 | 2 9 | 2 3 | 1 4 | 1 | |
| 7 | | | | | | 11 2 | 8 1 | 5.2 | 3 9 | 3 0 | 1 9 | 1 3 | |
| 8 | | | | | | 14 9 | 10 5 | 6 8 | 5 2 | 3 9 | 2 5 | 1 8 | 1 |
| 9 | | | | | | | 13 1 | 8 5 | 6 3 | 4 9 | 3 1 | 2 1 | 1 3 |
| 10 | | | | | | | | 10 7 | 7 9 | 6 2 | 3 9 | 2 8 | 1 6 |
| 12 | | | | | | | | 15 4 | 11 6 | 9 0 | 5 6 | 3 9 | 2 2 |
| 14" O D. | | | | | | | | | 14 0 | 10 9 | 6 9 | 4 7 | 2 7 |
| 15" O D. | | | | | | | | | | 12 6 | 8 0 | 5 5 | 3 1 |
| 16" O D. | | | | | | | | | | 14 4 | 9 1 | 6 3 | 3 8 |
| 18" O D. | | | | | | | | | | | 11 8 | 8 2 | 4 6 |
| 20" O D. | | | | | | | | | | | 14 7 | 10 0 | 5 8 |
| 22" O D. | | | | | | | | | | | | 12 4 | 7 0 |
| 24" O.D. | | | | | | | | | | | | 15 0 | 8 4 |
| 30" O.D. | | | | | | | | | | | | | 13 0 |
| 36" O.D. | | | | | | | | | | | | | 19 0 |

proportion of the heating season the regulator will have its valve only slightly open on account of its large area for the peak load requirements, with the result that the valve is very noisy and its disc and seat are soon ruined. It has been found in practice that two regulators, each connected to the initial and service pressures, will give better service than one of equal capacity. It is a very satisfactory arrangement to have one regulator rated at 60% of the steam requirements, and the other at 40% adjusting the smaller regulator to handle the minimum requirements, and the larger valve adjusted so that it will automatically come into service when the smaller regulator is unable to maintain the desired service pressure.

With this arrangement, as soon as the peak load is off, the larger valve will close tight and the smaller regulator will remain in service.

The following is intended to show the application of one regulator applied to an initial service pipe, and not more than 40 ft. from the steam header.

APPLICATION WHERE MINIMUM ATTENTION IS DESIRED

Fig. 2 is intended to show a method of applying a pressure regulator that has proven to be reliable in operation with a minimum of attention. The initial steam supply is connected to the top of the steam header where there is the least possibility of having condensation and sediment entering the initial pressure side of the regulator.

It is important to have a sediment separator with a free area through the strainer equal to the area of the supply pipe. This separator prevents solid matter such as scale, pipe chips and other solid objects from entering the regulator.

The sediment separator drain outlet should be connected to a suitable globe valve for the purpose of blowing out the accumulation of ordinary solid matter. The service pipe is shown with an outlet close to the regulator; this outlet is connected to a pop safety valve which should have sufficient discharging capacity to relieve any pressure above the maximum steam working pressure of the appliances connected to the service piping. It is advisable to use a pop safety valve with a side outlet connected to a pipe with one end open to the atmosphere where the discharged steam is not liable to cause property damage.

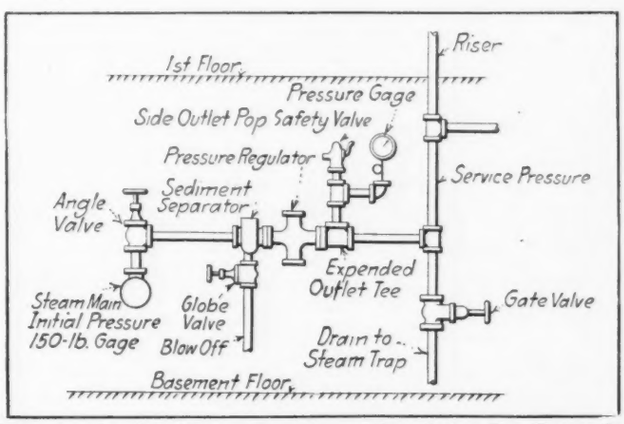


**Fig. 2—Application of Pressure Regulator for Operation with Minimum of Attention.**

A pressure gauge should be connected to the service pipe close to the regulator for the convenience of the attendant, this gauge to be graduated not more than 100 lbs. greater than the maximum service pressure. A gauge with a greater range of graduation makes it difficult to make a close adjustment of the service pressure. It has been found in practice that a pressure gauge graduated to 30 lbs. is more desirable than one graduated to 200 lbs. when the maximum service pressure is 10 lbs.

When it is necessary to extend the service pipe above the pressure regulator, it should be properly drained through a suitable steam trap so as to prevent any condensation from accumulating in the service pipe.

The importance of having the service pipe free from water is quite evident in the cause of safety to persons and property. When the regulator is in service it automatically supplies the steam at a reduced pressure according to the quantity of steam required for the service. It can readily be seen that when the service is discontinued the regulator will close the main valve, and will only open to supply sufficient steam to take the place of that which has been condensed in the service piping.

If the service piping is covered with a good grade of pipe covering, the rate of condensation will be slow, and it is possible for the reduced pressure service to be entirely closed for a period of time sufficient to have a considerable accumulation of condensation between the regulator and the riser in the service pipe. This would be a dangerous condition because when a valve is opened

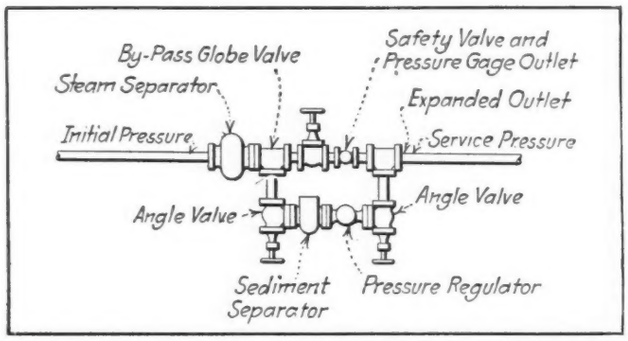


**Fig. 3—Application of Pressure Regulator with By-Pass.**

wide on the service pipe, the regulator will immediately respond, and when it opens the steam admitted into the service pipe comes in contact with the accumulated water and forces it at a high velocity through the service piping.

The water acts similar to the piston head of an engine, and when the water is forced by the steam it is very liable to break the piping system and cause serious injuries to the occupants, and damage to the stock of goods in a room where such a condition would occur.

If the regulator is adjusted to maintain 2 lbs. gauge service pressure, and the service pipe riser contained 6 ft. of water, there would be sufficient pressure on the regulator to keep it closed, and prevent the steam from flowing into the service pipe above the riser.

### PROPER INSTALLATION OF REGULATOR WITH BY-PASS

Fig. 3 shows in plan an application of a pressure regulator when it is desirable to have a by-pass so that it is possible to throttle the steam when the regulator is shut down for repairs.

This application is recommended when the regulator is located a considerable distance from the main steam header.

A steam separator, having its drain outlet connected to a suitable steam trap, should be connected close to the regulator, where the entrained condensation will be separated from the steam before it enters the regulator or the service piping.

The regulator is shown connected to the side outlets of the initial and service pressure piping, so that it can be removed from the line with a minimum of effort and interruption of the service.

This arrangement has proved in practice more satisfactory than if it were placed in the straight run of piping between the initial and service pressure tees.

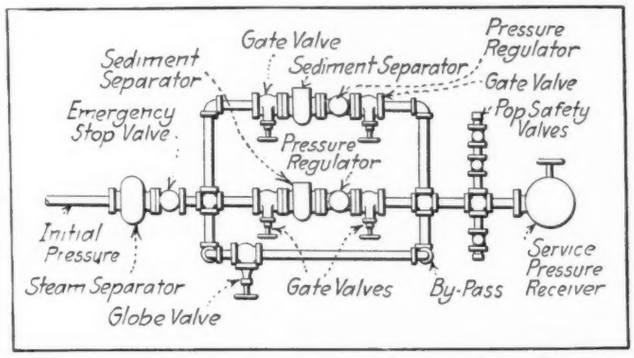


**Fig. 4—Application of Two Pressure Regulators Connected to the Same Service-Pressure Piping.**

Both of the angle valves may be closed and the by-pass valves having an area equal to 40% of the pipe size of the initial pressure piping are then opened to supply the emergency requirements until the regulator is again operated. With this arrangement it is a simple problem to remove the regulator from the service, when the angle valves are connected to the initial and service piping with threaded connections. If the valves and fittings are made of flanged material, it will be necessary to have the by-pass valve closed until the bolts on the outlet flange of the service pressure angle valve have been loosened, the regulator removed and the bolts tightened again; then the by-pass valve can be opened as desired. With this arrangement it is not necessary to have an expanded outlet regulator with the necessary increased size of the service valve and its connections. The tee on the service pressure connected to the angle valve should have an expanded run outlet equal to the size of the service pressure pipe to handle the steam at its reduced pressure.

The pop safety valve and steam gauge may be connected to a tee between the by-pass valve and the expanded outlet tee. With this application it is possible to have equally satisfactory regulation of the steam, and a reduction in cost and weight of the entire arrangement.

### PROCEDURE WHEN TWO PRESSURE REGULATORS ARE CONNECTED TO THE SAME SERVICE-PRESSURE PIPING

Fig. 4 shows in plan the application of two pressure regulators connected to the same service-pressure piping when the regulators are placed at a considerable distance from the main steam header, and are to supply a large quantity of steam to operate reciprocating engines and other steam apparatus.

A steam separator is provided to separate the condensation from the steam; the drain of this separator should be connected to a suitable steam trap.

An emergency stop valve is connected next to the steam separator which may be mechanically or electrically controlled. The electrically-operated valve is preferred because it is possible to have several remote controls where any attendant may push an electric button and cause the emergency valve to quickly close in case of an accident.

In some steam plants the push buttons are encased in a box having one side fitted with a small pane of glass; a small hammer is chained to the box which is used to break the glass for access to the push button, which is protected from unauthorized persons.

One regulator should have a rated capacity of 60% of the maximum steam requirements, and the other 40%. The smaller valve should be adjusted to open at a higher service pressure than the larger valve.

Assuming that the initial pressure is 200 lbs. gauge, and the maximum service pressure 125 lbs. gauge, adjust the smaller valve to open when the service pressure drops to 124 lbs., and the larger valve to open when the service pressure drops to 123 lbs. With this arrangement the smaller valve will handle the minimum amount of steam up to its capacity, and the larger valve will remain

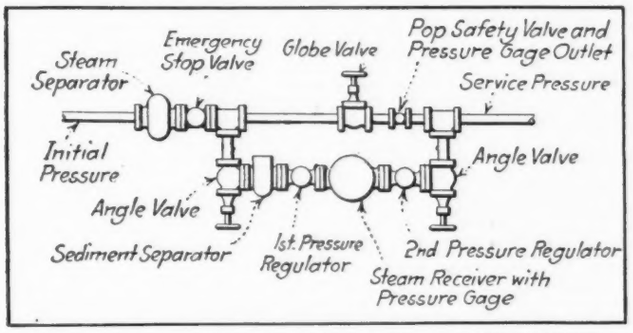


**Fig. 5—Arrangement of Two Pressure Regulators Connected in Tandem.**

closed until the demand for steam would be greater than the capacity of the smaller valve. In practice this arrangement has given satisfactory regulation of the serv ice pressure, requires less attention than when one regulator is used to furnish the steam for the same kind of service.

Each regulator is shown connected between two gate valves, preferably the outside screw and yoke type; there is also a sediment separator between each regulator and the initial-pressure gate valve.

A by-pass is shown with a globe valve; it is advisable to have the area of the by-pass equal to 40% of the area of the initial service pipe. The by-pass is intended for emergency service.

The service pressure outlets of each regulator are shown connected to a steam receiver that has its steam outlet connected to the main service pressure pipe. A receiver having a volume of sufficient size so that the maximum velocity does not exceed 1000 ft. per minute when the maximum amount of steam is being handled by both regulators, acts as a cushion when steam is supplied to reciprocating engines that are operated at a reduced pressure. It relieves the engine pulsations from effecting the flow of steam through the regulator.

If the pressure regulator is used to reduce the steam pressure to only one engine, it should not be connected close to the steam receiver separator of a reciprocating engine. By placing the regulator at a considerable distance from the engine connection, it will not be effected by the pulsations of the steam that are caused by the operation of the engine steam inlet valves.

It is advisable to connect one or more pop safety valves that have a total capacity to handle all of the steam that flows through the regulators in case there should be an excessive service pressure.

The outlets of the safety valves should be connected to an atmospheric pipe. By connecting a small whistle to the atmospheric pipe it will give an alarm when the safety valves are discharging the excess pressure.

When the application is used on superheated initial steam pressure service, a recording thermometer is recommended with its bulb fastened into the head of the receiver, especially when the service pressure is used to operate appliances that are not made for superheated steam service.

An electrically-operated bell should be arranged so that if the temperature of the steam exceeds the safety point it will give an alarm. The actuating device of this alarm should be connected to the receiver, and set to operate at a certain temperature of the steam within the receiver.

ARRANGEMENT OF TWO PRESSURE REGULATORS IN TANDEM

Fig. 5 shows in plan an arrangement of two pressure regulators connected in tandem when it is desirable to make the reduction of the initial steam pressure with two regulators.

The use of the steam separator, emergency stop valve, by-pass valve, safety valve and sediment separator, has been fully explained in Fig. 3.

The angle valve and the first regulator have the same pipe size as the initial-pressure pipe. The initial pressure is reduced to an intermediate pressure and discharged into a receiver in which the maximum flow of steam should not exceed 1,000 ft. per minute.

The outlet of the receiver has an expanded outlet which is connected to the second and larger regulator that is connected with an angle valve to the service pressure piping. This application is suitable for the reduction of the initial pressure from 100 lbs. gauge and higher to a pressure of 5 lbs. gauge and lower, where there is a considerable fluctuation of the initial pressure.

## Is Our Climate Changing?

*By G. J. O'Connor*
United States Weather Bureau.

Is the climate changing? No, not the climate; only the weather is changing. The climate of a country has to do as much with the soil and the products thereof as with the atmosphere that overlies it. The climate may be modified by man's efforts to overcome certain obstacles to soil cultivation and production.

For more than 30 years the United States government has been spending money liberally and effectively in the development of irrigation projects in the Far West and Southwest. Good results are shown in the reports of the growth in quantity and quality of staple products of that section.

After an Autumn of exceptional rains in the States from the Ohio valley to Kansas, New Mexico and Texas, it may be that water enough was stored in the pent-up

rivers and reservoirs in that extensively irrigated country to exert some influence in attracting winter storms somewhat further to the southward than is their customary course. December weather records attest the presence of storms of unusual severity in the Panhandle, Arizona, New Mexico and the Rio Grande valley, with heavy snows and near zero temperatures during that month.

The strange feature about this "climate change" would appear to be the "cornering" by that section of most of the cold weather in the United States during the month of December. It was so far out of the territory commonly traversed by cold waves and by commercial travelers dealing in "hot air," that it may be the means of opening up a new market for the latters' wares.

Stranger still was the perturbation which heating engineers had to contend with in the climate that is peculiarly their own. For, instead of weather that they might be contented with calling normal, they were openly confronted with a proposition to provide means for the "relief from heat" in the cities of the north and middle latitudes. Here the first month of winter scored a record, with temperatures far in excess of the normal. In New York the mean temperature slightly exceeded that of any December in fifty years of record. In Boston it equalled the highest of record, while in Pittsburgh it had been exceeded only once (1889), and twice in both Chicago and St. Louis in the same years (1877 and 1889).

As for snow, it was everywhere a negligible quantity and the same unusual winter conditions continued into the month of January.

# Air Leakage Through the Openings in Windows

## Results of New Tests at A. S. H. & V. E. Research Laboratory. Confirming Effectiveness of Weatherstripping and Furnishing New Data on Air Infiltration Through Walls

*By F. C. Houghten and C. C. Schrader*

*(From a paper presented at the annual meeting of the American Society of Heating and Ventilating Engineers, New York, January 23, 1924).*

THIS report deals with the methods employed and the results obtained for double-hung windows, 2 ft. 8 in. x 5 ft. 2 in. x 1⅜ in., in a 13-in. brick wall, plastered on the inside with cement plaster. Results are given for the leakage through such a window without weatherstripping, and with two types of weatherstripping, around the frame, and through the brick wall itself.

The apparatus shown in Fig. 2 was designed and built under the direction of the Research Laboratory. The brick wall was built, the plastering was done and the window hung by mechanics in the employ of large contracting firms in Pittsburgh. Every precaution was taken to make the wall and window represent work done by the ordinary contractor under the supervision of an architect.

For convenience in presenting, the results are given in two sections: (1) those obtained in a preliminary series of tests on the unweatherstripped windows in the wall as built, also with certain changes, such as calking the frame, sealing cracks, and painting the wall; (2) results obtained from a large number of tests with various sash, hung under different conditions, with and without weatherstripping.

Before making the first series of tests, the joint between the brick and the chamber wall was calked so that all leakage would take place through the wall or

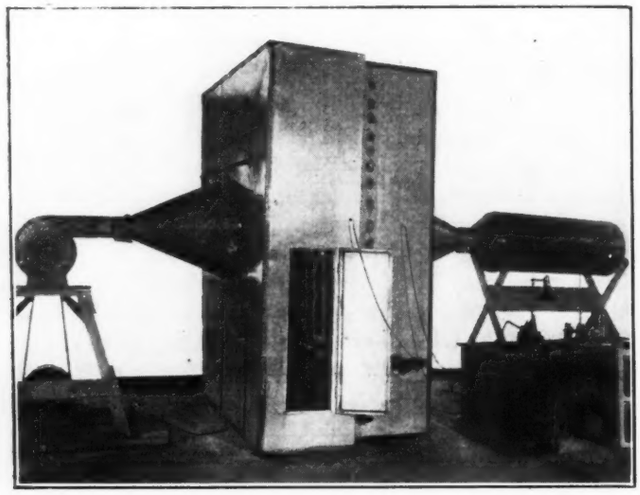

**Fig. 1—Apparatus for Testing Window Leakage.**

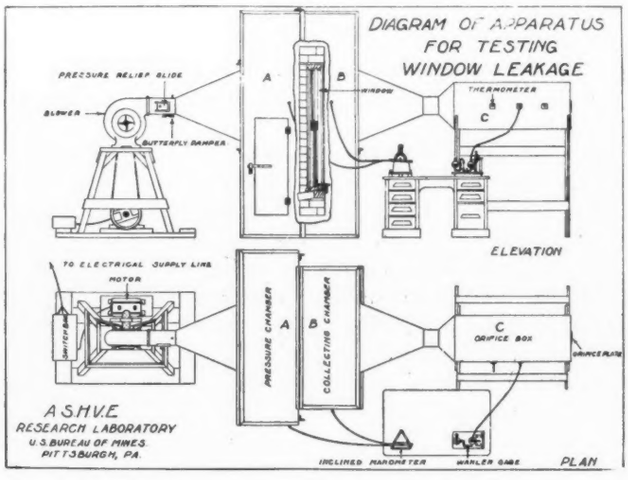


**Fig. 2—Diagram of Apparatus for Testing Window Leakage.**

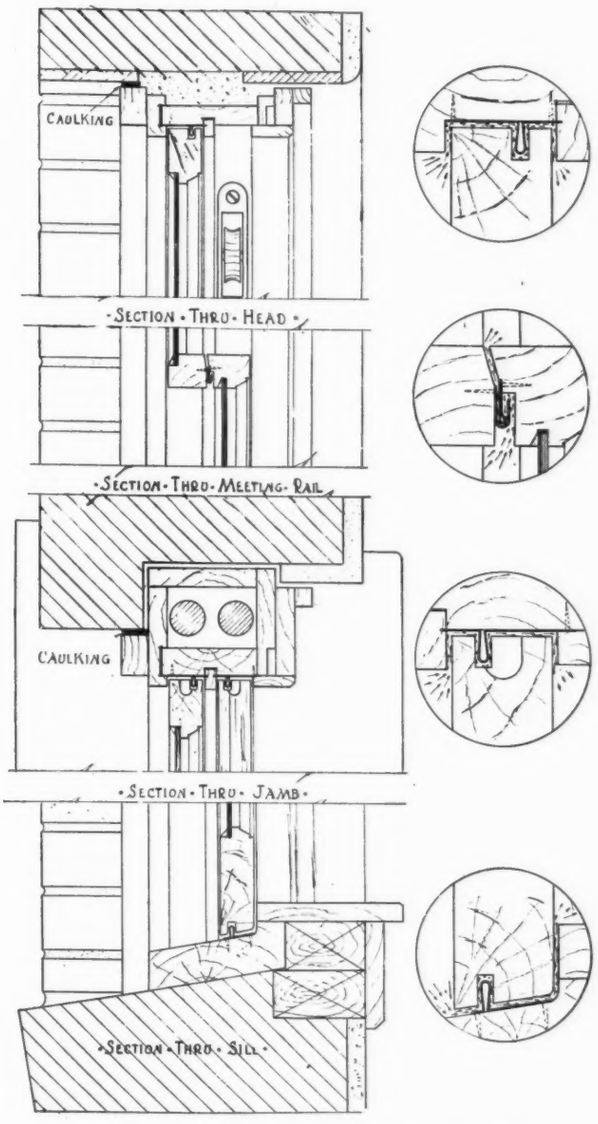


**Fig. 4—Details of Window with Rib-Type Weatherstripping.**

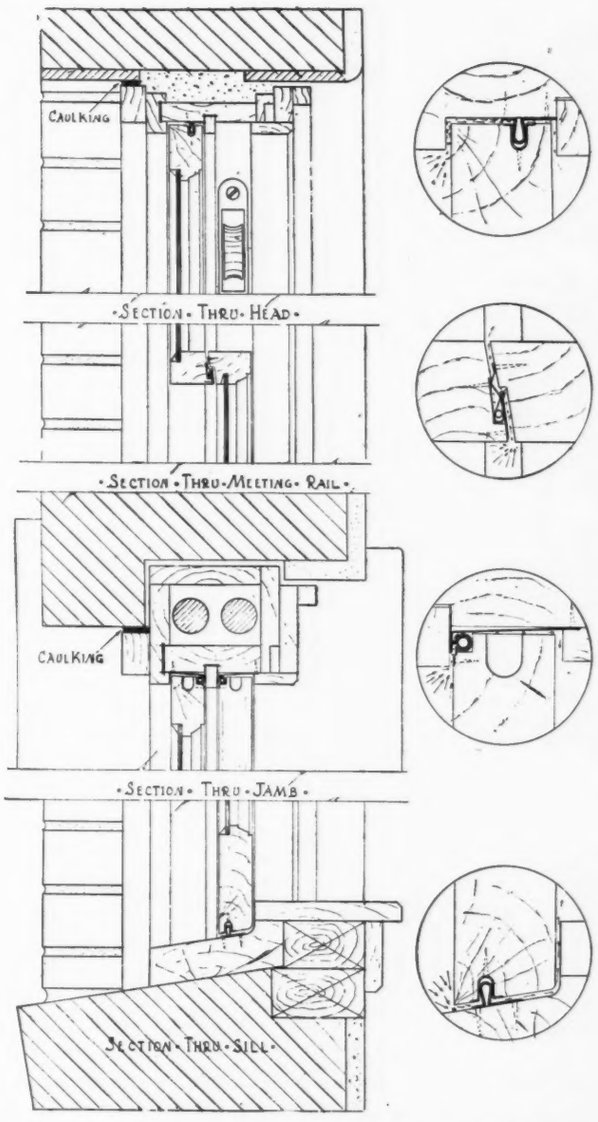


**Fig. 5—Details of Window with Interlocking-Type Weatherstripping.**

window. Curve 1, Fig. 6, shows the leakage for this condition for various pressures or wind velocities.

The second preliminary series of tests was made under the same conditions as the first series, excepting that the window was locked. Curve 2 shows the leakage for various wind velocities for the locked window. Locking caused a reduction in leakage of 20 C. F. M. with a 14.4-mile wind, and 64 C. F. M. with a 45.5-mile wind.

The third preliminary series of tests was made with the cracks around the sash perimenter, which are subject to weatherstrip application, sealed with a rubberized adhesive tape. This tape was tested and found to be as effective as a plastic calking compound. The leakage for this series of tests is given in Curve 3, and the difference between this curve and Curve 1 or 2 indicates the maximum possible reduction in leakage by a perfect weatherstrip. Before making the next series of tests, the staff bead, or brick mould, was removed and the crack between the frame and the brick wall calked. The brick mold was then replaced. Calking was also applied between the frame sill and the brick. The leakage for this condition is given in Curve 4, Fig. 6 and the difference between Curve 4 and Curve 3 gives the leakage between the frame and the wall, commonly called the frame leakage.

In order to determine the "elsewhere" leakage, a sheet of galvanized-iron was fastened by screws over the entire frame and the edges were sealed with calking compound. The leakage for this condition is given in Curve 5, Fig. 6. The difference between Curve 4 and Curve 5 is the leakage stopped by the galvanized-iron and is the "elsewhere" leakage.

Curve 5 shows a considerable leakage which does not go through the window opening, but through the brick wall and the plaster. To prove that this leakage was really through the brick wall, the wall was painted one coat with asphaltum paint and another series of tests made. The result of this series is shown in Curve 6. The difference between Curve 6 and 6 represents the leakage stopped by one coat of paint. Curves 7 and 8 show results with additional coats of paint.

### TESTS ON WINDOWS WITH AND WITHOUT WEATHERSTRIPPING

After completing the preliminary series of tests, a large number of tests was made with sash with and

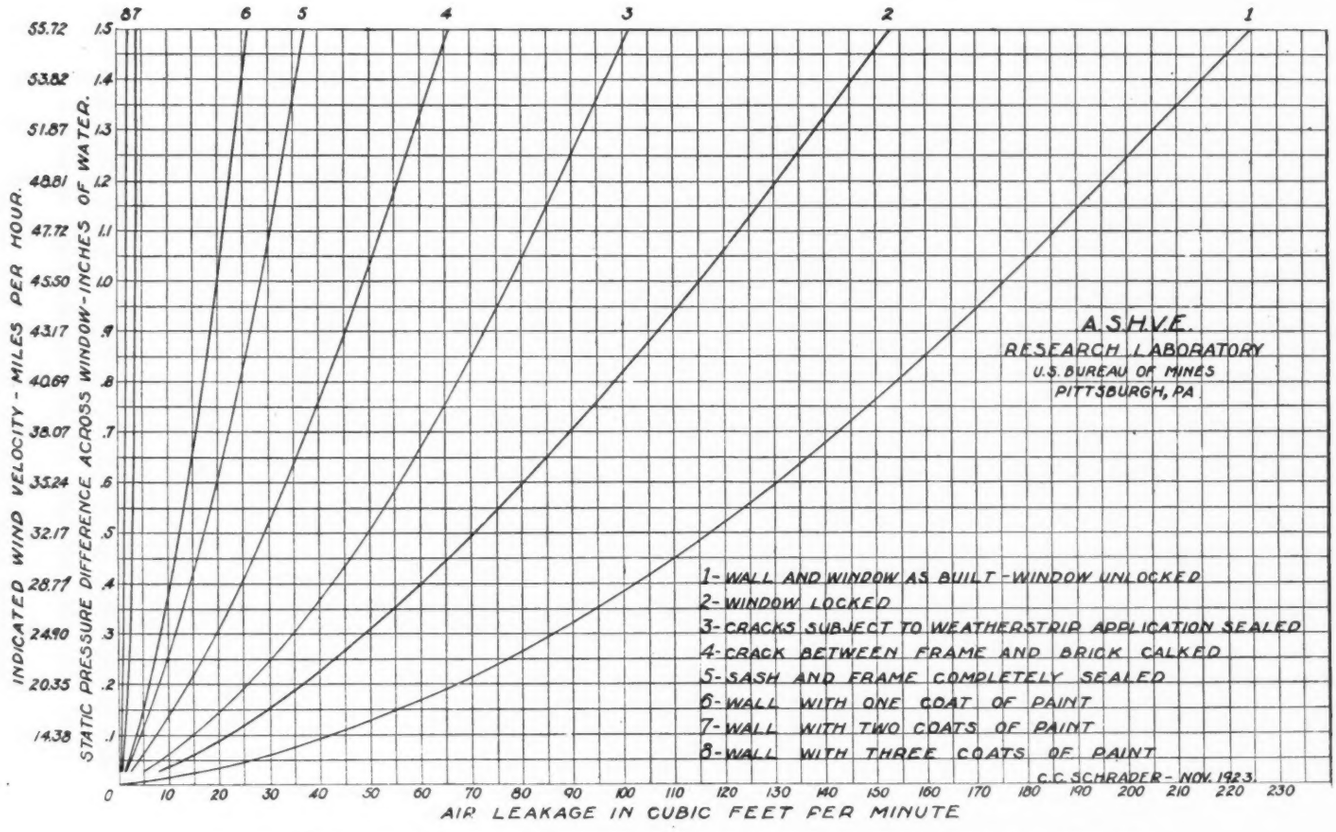
INDICATED WIND VELOCITY - MILES PER HOUR.
STATIC PRESSURE DIFFERENCE ACROSS WINDOW - INCHES OF WATER.
AIR LEAKAGE IN CUBIC FEET PER MINUTE
A.S.H.V.E.
RESEARCH LABORATORY
U.S. BUREAU OF MINES
PITTSBURGH, PA
1- WALL AND WINDOW AS BUILT - WINDOW UNLOCKED
2- WINDOW LOCKED
3- CRACKS SUBJECT TO WEATHERSTRIP APPLICATION SEALED
4- CRACK BETWEEN FRAME AND BRICK CALKED
5- SASH AND FRAME COMPLETELY SEALED
6- WALL WITH ONE COAT OF PAINT
7- WALL WITH TWO COATS OF PAINT
8- WALL WITH THREE COATS OF PAINT
C.C. SCHRADER - NOV. 1923.

**Fig. 6—Results of Tests of Leakage Through Various Parts of Window, and Wall.**

without weatherstripping, and with various widths of crack around the sash perimeter. Tests were made with cracks 1/16, ⅛, 3/16 and ¼ in., on both sides, top and bottom of the sash, without weatherstripping and with two types of weatherstripping. The size of the crack was increased to approximate the condition of windows that become loose as in old buildings. Figs. 4 and 5 show vertical sections of the window with the two types of weatherstripping, together with horizontal sections through one side of the sash and frame; also detailed sections of the various weatherstripped cracks. Fig. 3 showed a similar window unweatherstripped.

Figs. 7, 8, 9, 10 and 11 show the results secured in this series of tests. (In the paper as presented, the various curves are discussed at length and are accompanied by tables containing data taken from all of the curves, including those shown in Fig. 6).

Perhaps the most surprising fact brought out by the investigation is the leakage per square foot of wall. With a 15-mile wind each square foot of the 13-in. wall, plastered on the inside, allowed the passage of 0.111 cu. ft. of air per minute, while the leakage through the window and frame for the same wind velocity was 47.5, 9.7, and 7.8 cu. ft. per minute for the plain win-

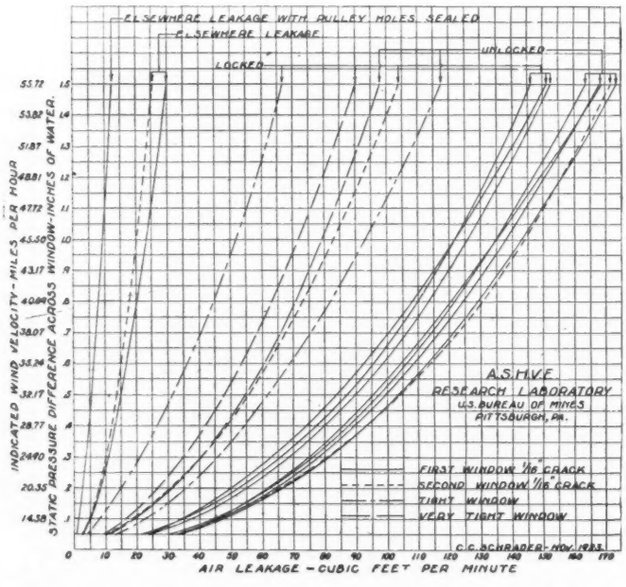


**Fig. 7—Results of Tests on Windows with Various Cracks, Showing Variation in Leakage for Different Tests on Same Window.**

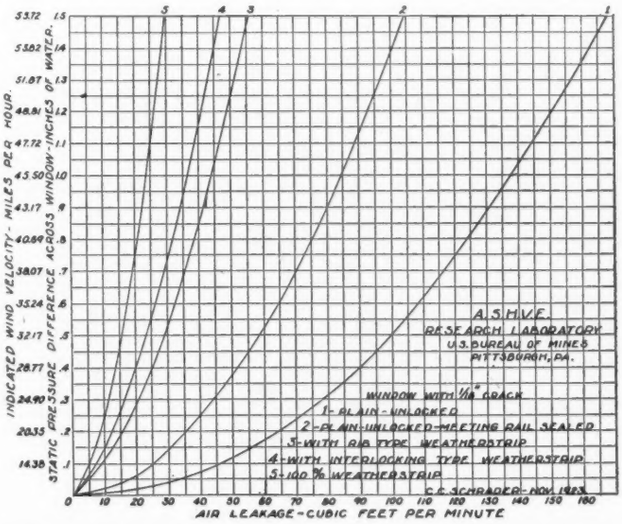
INDICATED WIND VELOCITY - MILES PER HOUR
STATIC PRESSURE DIFFERENCE ACROSS WINDOW - INCHES OF WATER.
AIR LEAKAGE - CUBIC FEET PER MINUTE
A.S.H.V.E.
RESEARCH LABORATORY
U.S. BUREAU OF MINES
PITTSBURGH, PA.
WINDOW WITH 1/16" CRACK
1- PLAIN - UNLOCKED
2- PLAIN - UNLOCKED - MEETING RAIL SEALED
3- WITH AIR TYPE WEATHERSTRIP
4- WITH INTERLOCKING TYPE WEATHERSTRIP
5- 100 % WEATHERSTRIP
C.C. SCHRADER - NOV. 1923.

**Fig. 8—Results of Tests on Window with 1/16-in. Crack Around Perimeter.**

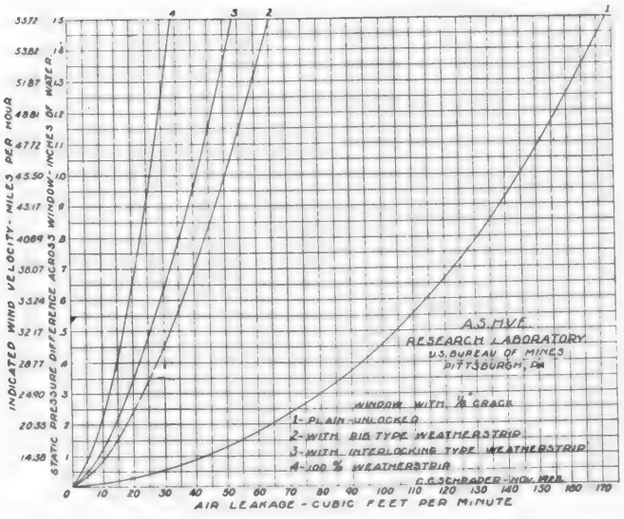
INDICATED WIND VELOCITY - MILES PER HOUR
STATIC PRESSURE DIFFERENCE ACROSS WINDOW - INCHES OF WATER
AIR LEAKAGE - CUBIC FEET PER MINUTE
A.S.H.V.E.
RESEARCH LABORATORY
U.S. BUREAU OF MINES
PITTSBURGH, PA.
WINDOW WITH 1/8" CRACK
1- PLAIN - UNLOCKED
2- WITH RIB TYPE WEATHERSTRIP
3- WITH INTERLOCKING TYPE WEATHERSTRIP
4- 100 % WEATHERSTRIP
C.C. SCHRADER - NOV. 1925

**Fig. 9—Results of Tests on Window with ⅛-in. Crack Around Perimeter.**

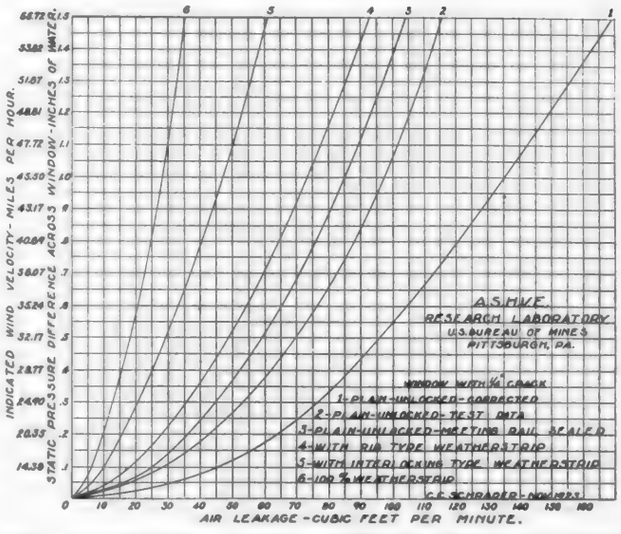
INDICATED WIND VELOCITY - MILES PER HOUR
STATIC PRESSURE DIFFERENCE ACROSS WINDOW - INCHES OF WATER
AIR LEAKAGE - CUBIC FEET PER MINUTE.
A.S.H.V.E.
RESEARCH LABORATORY
U.S. BUREAU OF MINES
PITTSBURGH, PA.
WINDOW WITH 1/4" CRACK
1- PLAIN - UNLOCKED - CORRECTED
2- PLAIN - UNLOCKED - TEST DATA
3- PLAIN - UNLOCKED - MEETING RAIL SEALED
4- WITH RIB TYPE WEATHERSTRIP
5- WITH INTERLOCKING TYPE WEATHERSTRIP
6- 100 % WEATHERSTRIP
C.C. SCHRADER - NOV. 1925

**Fig. 11—Results of Tests on Window with ¼-in. Crack Around Perimeter.**

dow and two types of weatherstripping, respectively. The area of the window and frame is 16.25 sq. ft., giving a leakage of 2.82, 0.697 and 0.48 cu. ft. per minute per square foot of window, without and with the two types of weatherstripping.

Based upon these figures, the leakage through the window and frame varies from 4 to 28 times that through the same area of wall. When we take into consideration the usual greater area of wall to window, it is evident that the leakage into a room is usually greater through the wall than through the window if weatherstripped, and not many times less if not weatherstripped.

It is of interest to compare the heat loss through windows and walls by transmission and by leakage. The leakage for the plain window and with two types of weatherstripping, all for 1/16-in. crack and a 15-mile wind, is 45.7, 9.7, and 7.8 cu. ft. per minute, respectively, representing a heat loss of 2580, 527 and 423 B. T. U. per hour, respectively, for a 50° temperature difference. A leakage of 0.111 cu. ft. per minute per square foot of wall represents a heat loss of 6.03 B. T. U. per hour for a 50° temperature difference. Taking the transmission through the wall as 0.28 B. T. U. per hour per square foot per degree temperature difference, this loss is 14 B. T. U. per hour for the same temperature difference. The heat loss, as thus indicated, by infiltration, is 43% as great as the heat loss by transmission, as indicated by the constant used.

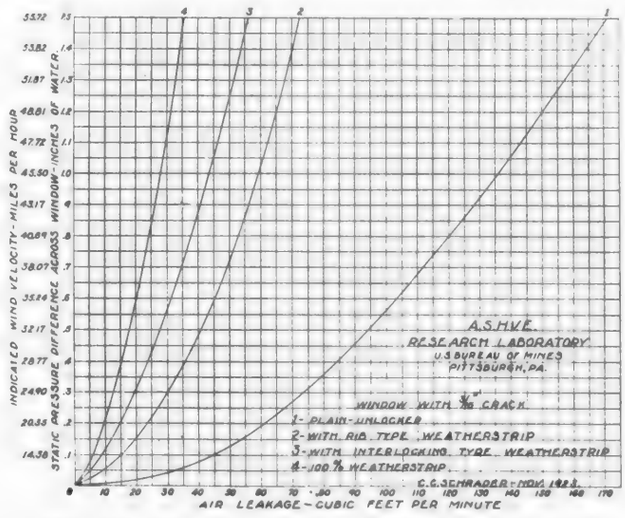
INDICATED WIND VELOCITY - MILES PER HOUR
STATIC PRESSURE DIFFERENCE ACROSS WINDOW - INCHES OF WATER
AIR LEAKAGE - CUBIC FEET PER MINUTE
A.S.H.V.E.
RESEARCH LABORATORY
U.S. BUREAU OF MINES
PITTSBURGH, PA.
WINDOW WITH 3/16" CRACK
1- PLAIN - UNLOCKED
2- WITH RIB TYPE WEATHERSTRIP
3- WITH INTERLOCKING TYPE WEATHERSTRIP
4- 100 % WEATHERSTRIP
C.C. SCHRADER - NOV. 1925

**Fig. 10—Results of Tests on Window with 3/16-in. Crack Around Perimeter.**

## Hints On Burning Steam Coal

In the preparation of domestic sizes of anthracite coal, states the Department of the Interior in Serial 2520, recently issued by the Bureau of Mines, a certain amount of smaller sizes (roughly 30% of the total) are produced, which are considered as a by-product and sold in competition with bituminous coal as steam coal, at a price below the actual cost of production.

Although these steam sizes can not often be burned alone with natural draft at a sufficiently high rate of combustion to produce the necessary amount of heat in the ordinary furnace, they are in use to a considerable extent, either mixed with some other coal or with coke, or unmixed using forced draft. The size usually used is No. 1 Buckwheat or yard screenings, although No. 2 and even mixtures of No. 2 and No. 3 buckwheat are used in certain localities with forced draft installations.

No. 1 buckwheat and yard screenings can be mixed with the larger domestic sizes (preferably egg coal), with coke or with bituminous coal. The proportions of the two sizes or kinds of coal are contingent on the size of the furnace with relation to the amount of heat to be supplied, on the draft available, or on the outside temperature, and can only be determined by experiment. They may range from equal quantities of each to one part of substitute to three parts of basic fuel. By trial it will be found that the proportion of substitute can be increased in mild weather when not a great deal of heat is necessary, but must be decreased or even omitted entirely during the most severe weather when the furnace must be operated to its maximum capacity.

When using small sizes with large anthracite or coke it is best not to mix them but to fire separately in layers, first a layer of the larger fuel and then a layer of the smaller. When used with bituminous coal which is not sized they should be mixed before firing.

Occasionally a furnace has sufficient grate area to burn a sufficient quantity of No. 1 buckwheat to produce the

necessary heat with natural draft. In that case, it is only necessary to reduce the size of the grate openings to prevent too great an amount of unburned coal falling into the ash pit. This can most readily and cheaply be done by laying a plate of iron, closely perforated with half-inch holes, or a piece of heavy half-inch square mesh galvanized iron netting, loosely on the grates. Such "false grates" will in time burn out but can be replaced at low cost.

Ordinarily it will be found that forced draft is necessary. This can be created by a small electrically-driven fan or blower connected with the ash pit and either automatically or manually controlled. The ash pit should be made as tight against air leakage as possible. The stove pipe damper must not fit tightly, to avoid the possibility of the furnace gases being forced into the cellar instead of escaping through the chimney should the damper be accidentally closed.

Copies of Serial 2520, "Fuels available for domestic use as substitutes for anthracite coal," by **Rudolph Kudlich**, may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C.

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## Remedying Defects in a Hot Water Circulating System

After our institution received a water bill that seemed extraordinarily large, I was called to the office and told to look into the conditions of things, and see if any means could be adopted to prevent such a bill. I did so, and inspected everything that might leak water. Everything was tight, and there was not even a leaky valve.

With things as they were it seemed impossible to reduce the water bill, but on noticing where and how the water was used a source of waste was soon revealed, and

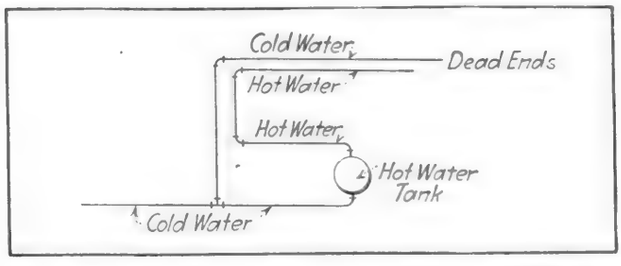


**Fig. 1—Hot Water Circulating System Which Proved Wasteful.**

such wastes are common in most buildings. When a drink of water was needed, many gallons of water were wasted in running off the warm water in the pipe in order to get a cold drink. On checking up this I learned that anywhere from 1 gal. to 10 gal. of water were wasted in order to get a cold drink, the amount varying at different locations of the outlets.

The main pipe contained several gallons, and on a warm day this water was not cold enough for a comfortable drink, and therefore was allowed to run to waste.

After due consideration the following was accepted and put in operation, which has proved to be very successful and convenient in several ways we did not expect at first. By referring to the sketch you can get a clear conception of what was done.

The sketch shows a very simple layout of piping that illustrates the principle. We had a kitchen and laundry that needed water at about 130° F. and with this in view we connected the dead end of our cold water line to the feed inlet of our hot water supply, and dis-connected the cold water, as shown in Fig. 2.

Then when hot water was used, it was replaced by water that passed through the cold water pipes of the house instead of coming direct from the main to the hot

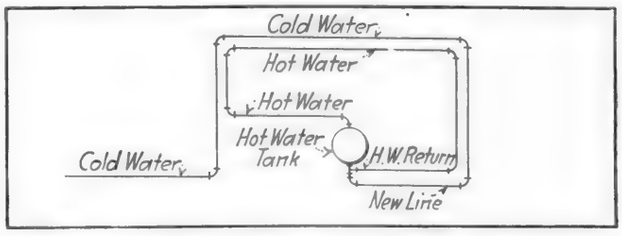


**Fig. 2—Changes Made in Hot Water Circulating System.**

water tank. In this new arrangement of piping the water at the taps was much cooler, and at many of the taps it was at all times cold enough to drink.

The next advantage was of considerable value because the water fed to the tank was raised from 10° to 15° F. on account of passing through the warm buildings, and near some hot water pipes. The cold water came in at about 45° F. It was then raised to about 57° F. in the building. This was about 15% of the heat applied to the water, which in the old way was absorbed by the water that was allowed to run to waste, and cause a disadvantage with a double expense.

Still another advantage was noticed, the reason of which can be seen by referring to the sketch. It stopped that uncomfortable experience which so often happens when the shower baths are being used, of having a shot of hot water suddenly come upon you on account of a tap or flush box valve being opened which instantly reduces the pressure in the cold water line, this allowing a greater volume of hot water to flow.

At such times it was almost impossible to get the proper temperature of the shower again until the troublesome flow of water stopped, and the pressure in the pipes was equalized.

In the new way, as seen in the sketch, there is only one entrance which supplies hot water at the same pressure, entirely avoiding the trouble to any marked degree. This, of course, brings a greater flow through the cold water supply which, in most cases, is large enough for the extra work put on it.

After enjoying these advantages we noticed that a large amount of water was wasted from the hot water lines in order to get hot water. This was overcome by connecting the dead end of the hot water line to the hot water tank, as shown in the sketch, with a check valve that works freely to prevent cold water from backing up when a tap was opened. The advantage gained was a constant circulation in the hot water system, supplying the tap with hot water at all times. C. RYE

# Short, Practical Method of Designing Gravity Water Heating Systems

## With Six Illustrative Problems Frequently Encountered In Practice, and Their Solutions

*By F. E. Giesecke*

*Professor of Architectural Engineering, University of Texas*

II

TO BE able to determine the proper size of the radiator of System I, presented last month, it is necessary to know the heat dissipation of the type of radiator selected. Very careful studies of the dissipation of heat by steam radiators have been made by Professor John R. Allen and other investigators. A summary of the results of their work, including a comprehensive table of direct steam radiation, was published in the Journal, A. S. H. & V. E., December, 1921.

Very little research has been conducted in the United States to determine the heat dissipated by water radiators. About thirty years ago Professor Rietschel conducted a series of tests which is described in *Gesundheits-Ingenieur* for October, 1896. Professor Rietschel's investigation shows that the heat dissipated by water radiators is about 10% less than that dissipated by steam radiators of like design and under like conditions.

In the absence of definite information regarding the heat dissipated by water radiators of modern American manufacture, the writer believes it well to assume the same to be about 10% less than the heat dissipated by steam radiators—for like temperature differences of

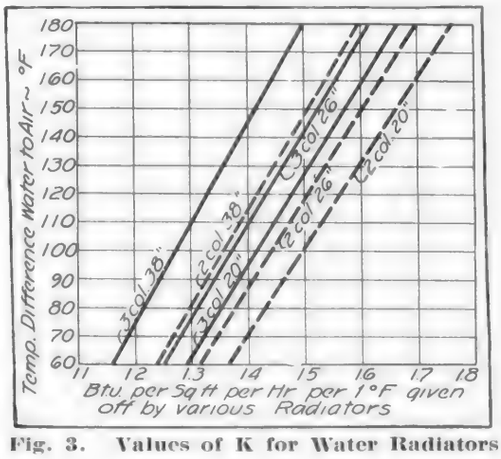


**Fig. 3. Values of K for Water Radiators**

the heating medium within the radiator and the air surrounding the radiator; and to assume also that the heat dissipated by a radiator varies with that temperature difference for water radiators as it does for steam radiators; i. e., that it "varies nearly 0.2% per degree above or below the standard range of 150°, as reported by Chas. A. Fuller" (Harding and Willard, Heating and Ventilation, p. 78.)

Based on these assumptions, Fig. 3 was constructed. It shows the values of K for 3-col. and 2-col. 38-in., 26-in., and 20-in. radiators, for temperature differences ranging from 60° to 180°. For 22-in., 32-in., and 45-in. radiators, and for 4-col. and 1-col. radiators, the values of K can be estimated with sufficient accuracy from the diagram.

We can now select a radiator for System I with the aid of the diagram of Fig. 3. The average temperature within the radiator is about 190°; the temperature of

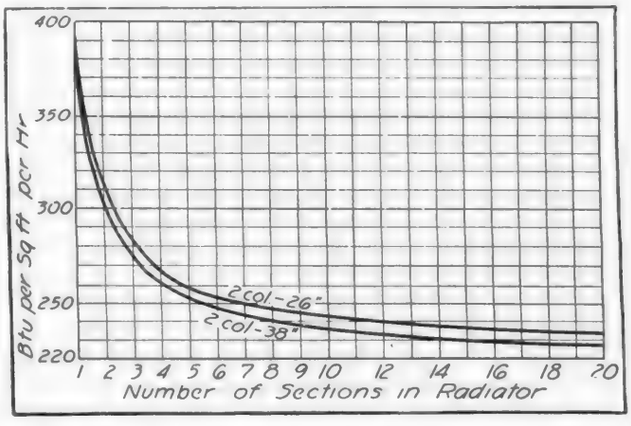


**Fig. 4. Heat Transmission for Radiators of Varying Lengths**

the surrounding air is 70°; the temperature difference is, therefore, 120°. If we decide to use a 3-col., 38-in. radiator, we find from Fig. 3 that the corresponding value of K is 1.33. Since the radiator is to dissipate 12000 B. T. U., it must have 12,000÷(1.33 x 120), or 75 sq. ft. Since the surface area of one section of a 3-col., 38-in. radiator is 5 sq. ft., we will select a radiator having 15 sections and 75 sq. ft.

If we have decided to use a 2-col., 20-in radiator we would have found the value of K to be 1.56, the required area to be 64 sq. ft., and the required number of sections to be 32. Such a radiator would generally be considered too long and would not be used.

The values of K, in Fig. 3, are for radiators having an average number of sections, say from eight to twelve. For very long radiators the value of K is slightly lower and for very short radiators it is considerably higher; this is due to the fact that the end sections of a radiator dissipate more heat than the interior sections.

### EFFECT OF LENGTH OF RADIATOR ON QUANTITY OF HEAT DISSIPATED

Professor John R. Allen made a careful study of the effect of length of radiator on the quantity of heat dissipated; the results of his investigation are shown in Fig. 4, which is reproduced here from the Journal, A. S. H. & V. E., January, 1920. A study of this figure shows that an end section dissipates about one-third

more heat than an interior section. Hence the heat dissipated by a 3-col. radiator is to that dissipated by a 10-col. radiator not as 3 is to 10 but as 3 2/3 is to 10 2/3, or as 11 is to 32. The variation in the average dissipation of heat by one section of a radiator can be accounted for in the calculation by varying the value of K proportionally.

For example, in the case of a 3-col. radiator K should be $(10 \times 11) \div (32 \times 3)$, or 1.15 times the K for a 10-col. radiator of the same type. To avoid the necessity of such calculations in the design of heating systems,

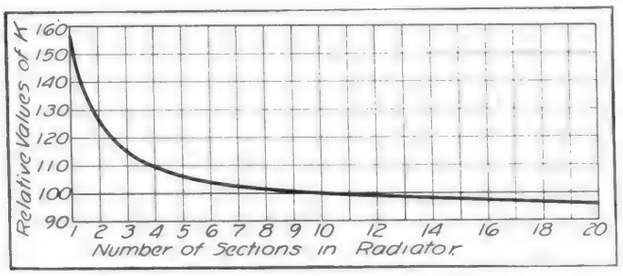


**Fig. 5. Relative Values of K for Radiators of Varying Lengths**

Fig. 5 was constructed so as to give the values of K for radiators varying in length from 1 to 20 sections in terms of the values of K for a radiator having 10 sections, which are given in Fig. 3.

In practice it is not necessary to modify the value of K for the variation in length of the radiator except when the radiator is a very short one; i. e., when it has fewer than 6 sections.

### DESIGN OF SYSTEM IA

Let it be required to design the pipe lines and the radiator for the conditions shown in Fig. 6.

System Ia differs from System I only in having a longer pipe line, a larger number of elbows, and a radiator valve. System I is an ideally simple system; more simple, probably, than would ever be used in practice. System Ia more nearly represents average conditions as found in actual installations.

The method of design is exactly the same as that described for System I and will be followed here in the same order as before.

The pressure-head is, as for System I, 7 x 90 or 630 m.i.

The friction-head for the radiator circuit is due to 1 heater, 1 radiator, 27 ft. of pipe, 11 elbows, and 1 radiator valve. According to the tabulation above, the frictional resistances in the heater, radiator, and radiator valve are, together, equal to those in eight elbows; hence the total friction in System Ia may be considered equal to that in 27 ft. of pipe and 19 elbows, and should be 630 m.i., as nearly as practicable. The correct pipe sizes are found by trial, as explained for System I.

Assume a 1-in. pipe; the total friction-head is

$27 \times 18 = 486$
$19 \times 35 = 665$ 1151

or 521 m.i. more than the available pressure-head.

Assume a 1¼-in. pipe; the total friction-head is

$27 \times 5 = 135$
$19 \times 11 = 209$ 344

or 286 m.i. less than the available pressure-head.

The correct pipe size is, therefore, more nearly 1¼-in. than 1-in. It may be sufficiently accurate to make the flow line one of those sizes and the return line the other size.

The flow line is equivalent (in frictional resistances) to 12 ft. of pipe and 9 elbows; the return line, to 15 ft. of pipe and 10 elbows. These data were derived from Fig. 6; the length of pipe was scaled on the drawing; the number of elbows were counted; the angle radiator valve, which is equivalent to two elbows, is a part of the return line; one-half of the radiator equivalent and one-half of the heater equivalent were added to each of the two lines.

Assume a 1-in. pipe for the flow and a 1¼-in. pipe for the return line; the total friction-head is

$12 \times 18 = 216$
$9 \times 35 = 315$ 531 (in flow line)
$15 \times 5 = 75$
$10 \times 11 = 110$ 185 (in return line)

Total 716

or 86 m.i. more than the available pressure-head.

It was shown for System I that a difference of 81 m.i. between the calculated friction-head and the calculated available pressure-head was too small to interfere materially with the desired performance of the system. We may conclude, in this case, if we install the system as calculated, with a 1-in. pipe for the flow line and 1¼-in. pipe for the return line, and have a deficiency in the available pressure-head of 86 m.i., that steady circulation will prevail in the system with a temperature difference of about 21°, instead of 20°, when the radia-

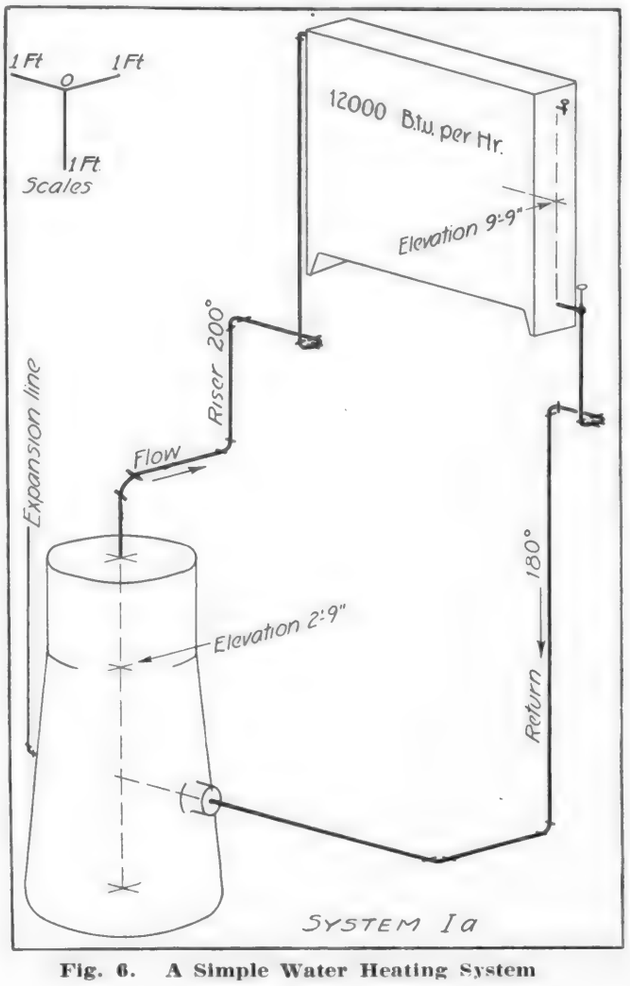


**Fig. 6. A Simple Water Heating System**

tor is delivering 12,000 B. T. U. per hour to the room, and that this will meet the requirements of the problem sufficiently well.

The radiator in System Ia should be like the one in System I.

DESIGN OF SYSTEM IB

Let it be required to design the pipe lines and radiator for the conditions shown in Fig. 6, but for a temperature difference in the flow and return risers of 40°, instead of 20°, as there shown for System Ia.

System Ib will differ from System Ia in having its circuit made up of smaller pipes and a larger radiator.

The pressure-head is, from Diagram I, for 200° and 160°, 7 x 174 or 1218 m.i.

To find the friction-head, we must remember that since the temperature-drop through the radiator is increased in the proportion of 20 to 40, or of 1 to 2, the quantity of water which must flow through the radiator and the velocity of the water in the pipe lines must both be reduced in the proportion of 2 to 1, and that the friction-head in the system is the same as it would be for a 20° temperature difference if the quantity of heat conveyed were reduced in the proportion of 2 to 1. Diagram II can, therefore, be used and the friction-heads corresponding to one-half of 12,000, or 6,000 B. T. U. found instead of those corresponding to 12,000 B. T. U. We may then proceed with the design as before.

Assume a 1-in. pipe; the friction-head, according to Diagram II is 5 m.i. per foot of pipe and 9 m.i. per elbow. The total friction-head is

$$27 \times 5 = 135$$
$$19 \times 9 = 171 \quad 306$$

or 912 m.i. less than the available pressure-head; a 1-in. pipe is therefore entirely too large.

Assume a ¾-in. pipe; the friction-heads are 16 m.i. per foot of pipe and 24 m.i. per elbow. The total friction-head is

$$27 \times 16 = 432$$
$$19 \times 24 = 456 \quad 888$$

or 330 m.i. less than the available pressure-head; a ¾-in. pipe is, therefore, slightly too large.

In most cases it would be undesirable to use a ½-in. pipe in a water radiator circuit and we would make the installation for System Ib with ¾-in. pipe, knowing that circulation will take place with a temperature-drop sowewhat less than 40° when the radiator is delivering 12,000 B. T. U. per hour. Proceeding as explained for System I, we can find, by means of a diagram similar to that of Fig. 2, that circulation would take place with a temperature difference of about 36°.

To find the proper size radiator, we note that the mean temperature of the water in the radiator is about 182° and that the temperature of the surrounding air is 70° and their difference is 112°; we note also, from Fig. 3, that the value of K for a 3-col., 38-in. radiator and for a temperature difference of 112° is 1.31. The required radiator surface is, therefore, 12,000 ÷ (1.31 x 112) or 82 sq. ft., instead of 75 sq. ft., as found for System Ia.

The engineer must decide, for each individual installation, which temperature-drop through the radiator will secure the most satisfactory design. As the temperature-drop is increased the pipe sizes are decreased and the radiator sizes are increased. These changes affect the cost of installation as well as the cost of operation; they also affect the quantity of heat dissipated by the pipe lines, which may or may not be useful, and the quantity of water required to fill the system which, in turn, affects the time required to heat up and to cool down.

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The next section to appear in March will explain the design of a one-pipe system for a small building.

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## Steam Conduit System for the Dupont Horticultural Buildings

*By F. Lynn Cason*

**One of the most notable heating installations of its kind is that in the Dupont Horticultural Buildings, in Longwood, Inc., near Wilmington, Del. Some of the most notable features of this installation were described in *THE HEATING AND VENTILATING MAGAZINE* for June, 1923. It now remains to describe the underground system of steam distribution from the Horticultural Group to the Mansion House, supplemented by an efficiency test, showing the possibilities in the insulation of pipe conduits.**

THE underground steam main which forms part of the heating system for the Dupont Horticultural Buildings, in Longwood, Pa., runs from the Horticultural Group, where the main boiler plant is located, to the Mansion House, which comprises the residence, garage, vegetable greenhouse and gardener's cottage. It eliminates three coal-fired, low-pressure steam heating boilers, a water heater in the vegetable greenhouse, and a warm-air heater in the gardener's cottage. The residence and garage are served with vapor heating systems, while the vegetable greenhouse and the gardener's cottage have water heating systems in which the water is heated by means of hot water converters.

The equipment in question consists of a 4-in. steam main and a 2-in. return, encased in a 15-in. internal diameter, longitudinal-split, sectional tile. This tile is a hard-burned, salt-glazed, vitreous tile of a thickness specified by the Eastern Sewer Tile Manufacturers.

The conduit was laid on a 6-in. bed of crushed rock of 1-in. size, and after being sealed, was covered to within 5 in. of the top with the crushed rock.

For drainage around the conduit, a 6-in. vitrified underdrain was laid in a bed of crushed rock under the entire system and connected to existing sewers. While the trench was being filled, the open joints of the drain were protected by 1½ laps of burlap 6 in. wide.

The insulation in the conduit consist of a loose filler that is composed of asbestos fiber and a special oil-treated rock wool, neither of which is injured by heat or water.

The specification stated that neither steam nor return pipe should have less than 3 in. of insulation and that the insulation should be packed firmly enough to prevent settling which would leave air spaces above the pipe. Sections of the pipe which passed through the manholes

were covered with 2-in. thick 85% magnesia, which, in turn, was covered with four-ply asbestos felt, applied with high temperature pitch. The expansion joints were covered with a removable insulation built up of 2-in. hair felt laced into place.

The pipe supports consist of cast-iron frames wedged on saddles which in turn rest on pre-cast concrete blocks, spaced every 12 ft. The pipes are carried on 1-in. cold-rolled steel shafts fitted into the frames and separate sherardized iron rolls, graphited.

The steam main is of standard, full weight, "spellerized" steel pipe, while the return is specified as extra-strong, "spellerized" steel pipe. All pipe couplings on the underground steam and return lines are extra-heavy, screwed, wrought-iron, welded in place so as to make a continuous joint.

All underground steam and return lines, before being covered, were filled with water and tested to 150 lbs. hydrostatic pressure, all air being removed from the system.

A test of the system by the consulting engineer, Robert P. Schoenijahn, of Wilmington, Del., was made to determine its thermal efficiency and to verify the manufacturer's guarantee that the insulation would show an efficiency of not less than 90%.

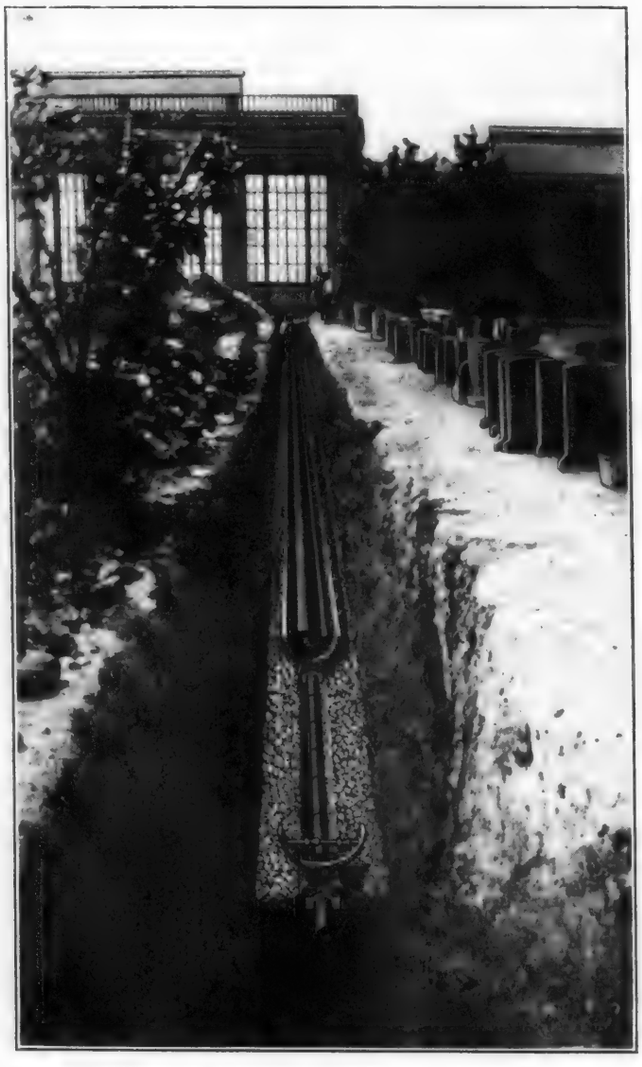

**Fig. 1—Steam Conduit System at Dupont Horticultural Buildings During Course of Construction.**

The term, "thermal efficiency," in this case is defined as the ratio of the saving effected by the insulation, to the thermal loss from bare pipe in still air, under the same temperature differences. The following is the formula used:

$$E = \frac{H_1 - H_2 \times 100}{H_1}$$

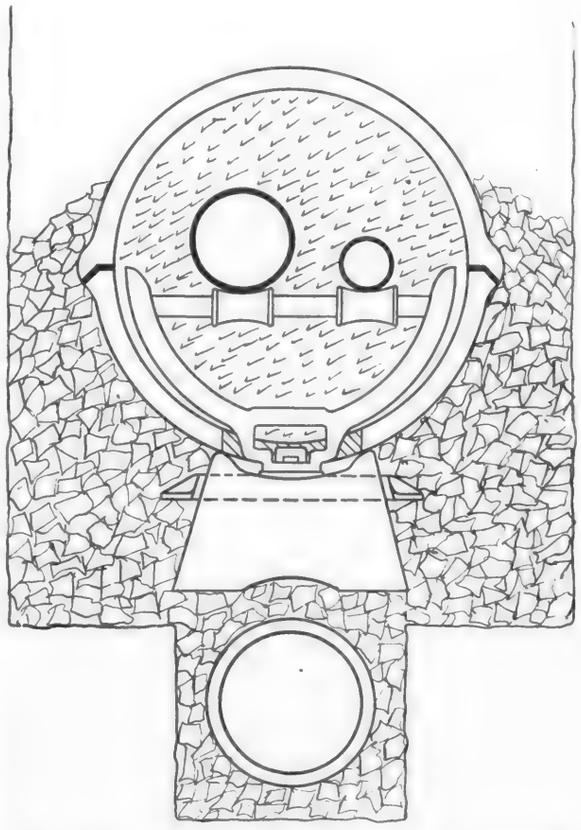

**Fig. 2—Section of Steam Pipe Conduit, Showing Insulation and Under-Drainage.**

in which E is the thermal efficiency, in percentage of the insulation.

$H_1$ equals the thermal loss from bare pipe in still air for temperature differences equal to test conditions. based on experiments by Professor L. B. McMillan.

$H_2$ equals the thermal loss from the underground insulated pipe as determined by test conditions.

The section of the underground line tested is the 4-in. steam pipe from manhole L, at the easterly end of bridge, over Doe Run Road, down to the garage, point S; there being three manholes, M, O, and Q, in this line. The diagram shows the run of conduit tested.

In manhole L at bridge, a section of 4-in. flanged pipe was removed and 1¼-in. connections installed, with high-pressure gauge, throttling valve, throttling calorimeter and low-pressure steam gauge, as shown on diagram. At the low end of the main in garage, point S, the 4-in. line was disconnected and 1¼-in. pipe installed at the 4-in. drain tee, with gauge glass, pressure gauge, air vent and drain valve for removing condensation. The condensation accumulating at the low points was weighed in buckets on a platform scale.

In conducting the test the steam pressure was maintained constant at the point of entrance by means of a

throttle valve. At the low end, point S, the drain valve was regulated to maintain a constant level in the gauge glass. Readings were taken at 15-min. intervals. The test was conducted for some time previous to the readings and only those readings were used after the rate of condensation became practically constant.

The following is a table of important data and results of calculations which show that the insulation for the steam pipes in the underground conduit system effected an efficiency of 90.4%.

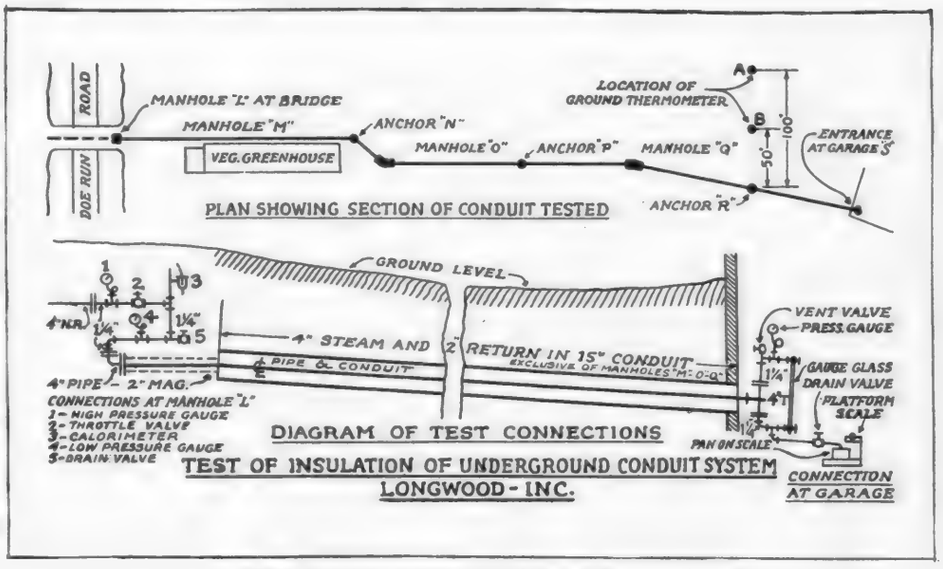


**Fig. 3—Arrangement of Test Connections.**

TEST OF INSULATION ON STEAM LINE IN UNDERGROUND CONDUIT SYSTEM AT LONGWOOD, INC.

Date of test.....December 6, 1922.
Weather.....Cold and clear.
Duration. . .. .....2 hrs. 30 min.
Duration of test as calculated—3:15 to 5:15 P.M. .....2 hrs. 0 min.
Average outdoor temperature, deg. F.....33½
Average ground temperature, deg. F. .....46
Average steam pressure in high-pressure main, lbs. gauge. . . . .37½
Average steam pressure in tested line at point of entrance manhole L, lbs. gauge.....8
Average steam pressure in tested line at end of main, point S, lbs. gauge.....8.1
Temperature of steam in test main, deg. F.....234.8
Quality of steam entering test main, per cent....99.81
Total weight of water collected at 212° F. 102 lbs. 3½ oz.
Weight of steam condensed per hour.....51 lbs. 1¾ oz.
B. T. U. loss per pound steam condensed at 8 lbs. gauge pressure.....955.4
Total B. T. U. loss per hour due to condensation, as weighed.....48,830
Deductible B. T. U. loss per hour due to initial moisture in steam..... 93
Deductible B. T. U. loss per hour due to pipe not in conduit.....2750 2,843

Net B. T. U. loss per hour due to pipe in conduit..45,987
Net linear feet of 4-in. main in conduit.....822
Net square feet exterior surface of pipe in conduit..968 (1.178 sq. ft. per linear foot)
$H_2$—B. T. U. loss per square foot per hour from pipe in conduit.....47.5
B. T. U. loss per square foot per hour per degree difference (1888.8).....0.251
$H_1$—B. T. U. loss per square foot per hour from bare pipe 4 in. diam. with temperature difference of 1888.8°.....495

Thermal Efficiency

$$E = \frac{H_1 - H_2 \times 100}{H_1}$$

$$E = \frac{495 - 47.5 \times 100}{495}$$

$$E = 90.40\%$$

It may be of interest to express the results of this test in the fuel equivalent, due to the main losses starting with the steam line at point of connection under house No. 9, and terminating at the garage.

The calculations were made for the actual length of pipe and the various kinds of insulation with average steam pressure of 35 lbs. gauge.

1100 lin. ft. of 4-in. main in conduit 90% eff.:
temp. difference 240° F., bare pipe
Loss 820 B.T.U. per lineal foot
Loss in 1100 ft.—10% loss, B.T.U..... 90,200

Losses in buildings:
380 ft. 5-in. pipe 2 in. magnesia—1.46 = 555 sq. ft.
360 ft. 4-in. pipe 2 in. magnesia—1.178 = 430 sq. ft.
surface.....985 sq. ft.
Temperature difference 220°
Loss per square foot 2 in. magnesia—0.32
985 × 220 × 0.32,—B.T.U..... 69,400

TOTAL LOSS, B. T. U..... 159,600

Heat of vapor—35 lbs. gauge 923.5 B.T.U.:
Total loss, pounds condensation per hour..... 173
for 5,000 hrs. per year, pounds..... 865,000

Assuming 13 lbs. evaporation per pound of fuel-oil:
Equivalent pounds of oil per year..... 66,500
at 8 lbs. per gallon, gal..... 8,313
Oil at $0.0385 per gallon
8313 × 0.0385 = $320.05 cost per year due to condensation.

$180.80 = cost per year due to condensation in conduit
$1627.20 — Saving over bare pipe per year due to conduit insulation.

# The Economical Utilization of Heat From Central Station Plants

## Points on the Design of Building Layouts to Secure a Maximum of Service with a Minimum of Expense

*By N. W. Calvert and J. E. Seiter*

(*From a Paper Presented at the Annual Meeting of the American Society of Heating and Ventilating Engineers, New York, January* 23, 1924)

THE great increases in operating costs during the past decade and the consequent increase in consumers' rates for heat supply have directed the attention of district heating engineers to the need of improved design and more intelligent operation of the consumer's heating system. That there has been room for some improvement in this direction has always been evident, but the great possibilities of economy have only recently been realized.

The operation of a steam heating system supplied from a central plant is fundamentally different in several respects from the operation of an isolated plant and system. In the case of an isolated plant, the variation in the amount of heat furnished to a building depends almost entirely on the rate of firing the boiler, whereas with central station heat, there being an unlimited supply, the amount of heat used depends entirely on the method of operation.

While this unlimited supply lends a marked flexibility of operation, it also presents a great possibility of waste, inasmuch as with the isolated boiler a positive act, such as putting on fuel or opening drafts, is necessary to maintain the supply of heat, thus increasing the cost of heating; whereas with central heat the positive act is required to cut off the heat supply, thereby reducing the heating cost. This difference may be exemplified by assuming a building being heated and no attention paid to it. If it is served from an isolated plant the fire soon dies and the expense practically ceases, but if it is using central heat, as long as the supply valve is left open, the expense continues.

With an isolated plant the complete utilization of the B. T. U. content of *the steam* is not essential because the condensate returns to the boiler at a high temperature and less fuel is required to make it into steam again. With central heat, however, complete utilization is essential for economy, as the consumer must pay for every B. T. U. which is put into the steam and consequently suffers considerable loss if 10% to 15% of the total heat content of the steam is sent to the sewer with the condensate.

Naturally the greatest saving by proper operation is to be expected during the periods when demand for heat is light, such as mild weather periods, night hours and times when the building is unoccupied. The fixed losses under light load and no load conditions are much less with central heat than with an isolated plant. A slight economy is sometimes effected by varying pressure conditions on the heating system and central service lends itself more readily to pressure variation than an isolated plant.

The two methods of supply, then, present different problems. In general these problems divide themselves into two classes, *first,* as to proper control of heat supply, and *second,* as to the efficient use of heat.

### ECONOMY OF SHUTTING OFF STEAM AT NIGHT

As has been mentioned, the greatest economy is effected by shutting off steam entirely, especially during the night when the majority of buildings are unoccupied. Inasmuch as the rate of heat transmission from a building is dependent on the differential temperature between the interior and exterior, it is evident that when the interior temperature is reduced heat will not be given up by the building as rapidly as if a high temperature is maintained. In buildings where steam is left on during the night, the interior temperature frequently increases and consequently the loss by transmission through the building walls increases. Investigations have been made of the rate of cooling of various buildings. Fig. 1 shows cooling curves plotted for one building investigated.* The average building cools very slowly and it is possible by a knowledge of the rate of cooling to utilize, during the period in which the building is occupied, a large proportion of the heat put into the building. Referring to Fig. 1, for instance, it is evident that

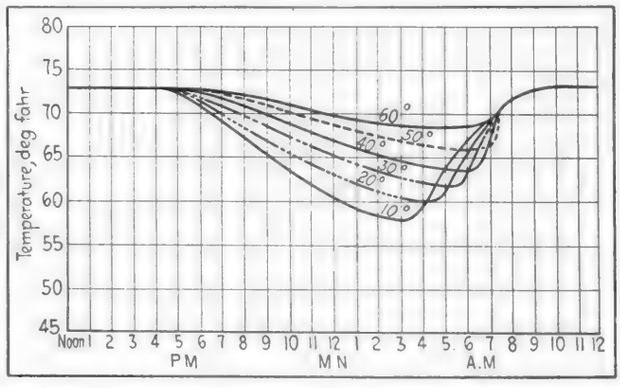


**Fig. 1. Rate of Cooling of Office Buildings with Various Outdoor Temperatures**

steam might be shut off in this office building an hour or two before closing time without making the building uncomfortable for the occupants, inasmuch as in the coldest weather during the test the rate of temperature drop was only 5° in 3 hrs. Fig. 2 shows the saving effected in daily steam consumption by shutting off during night hours.

It should be noted here, however, that a building must have sufficient radiation to heat up readily in the morn-

* These curves were plotted from actual tests but have been shifted slightly for the sake of clearness so that they coincide during the middle of the day.

ing, as instances have been found where buildings with insufficient radiation required steam on all night in order to have a suitable temperature during business hours, with consequently increased steam bills. Excessive radiation, on the other hand, also increases the consumption by overheating the building and necessitating the opening of windows.

### SHUTTING OFF STEAM DURING THE DAY

The weather during a heating season might be divided into three classes, mild, cold and extremely cold. The last named generally constitutes only 5% to 10% of the entire heating season, and inasmuch as the heating system is designed to care for extreme conditions, it is logical that some adequate means of control should be

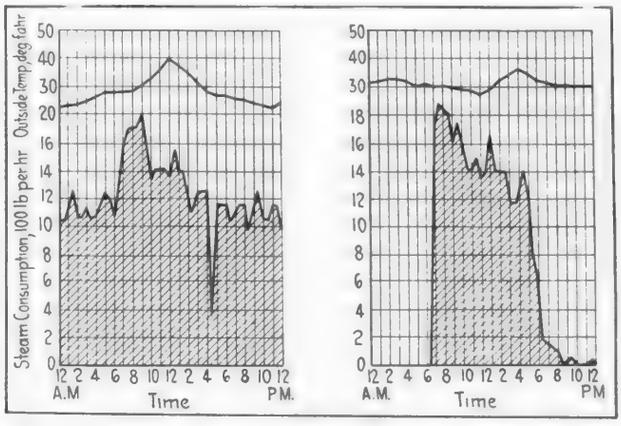


**Fig. 2. Load Curve Showing Savings Possible by Shutting Off at Night**

Type of building—Office building
Radiation—5865 sq. ft.
Steam consumption for day—29.170 lbs.
Mean outside temperature—31° F.
Mean wind velocity—W. 18.2
Steam consumption for day—15,000 lbs.
Mean outside temperature—32° F.
Mean wind velocity—N. 11.8

provided for use during the periods when these extreme conditions do not exist. In many buildings the heat can be entirely shut off during ordinary weather for many hours of the day as well as at night. Fig. 3 shows savings effected by turning on and off steam at intermittent periods during the day in a large department store without creating an uncomfortable temperature. This saving is especially interesting when the necessity for adequate heat in such a building is considered.

### INSTALLATION OF A 24-HOUR MAIN

A condition frequently met is that in which, on account of incorrect design of the heating system for central heat, it is necessary to heat the entire building or at any rate a large portion of it for 24 hours a day, because heat is required in one small part of it. This condition is especially true in hotels and clubs, where a lobby must be heated at all times. The same condition exists in office buildings where a small cigar store or an all night restaurant is located. There are also many buildings where the steam for the sprinkler tank is taken directly from the heating system, which, therefore, cannot be shut off without endangering the fire equipment. There are garages with a small office to be heated at times when the garage proper needs no heat.

The remedy for such cases is a separate main run from the service point to the part of the building requiring continuous service. The balance of the heating system may be shut off at all times when the building in general is unoccupied with a resultant economy in operation.

Fig. 4 is a diagram of the layout of such a 24-hr. main serving in this particular building the sprinkler system, elevator shafts, toilet rooms, lobby and telephone operators' room which are occupied at all times. This main is also designed to take care of the building restaurant requirements and therefore is used during summer months. Needless to say, this arrangement should be planned when the building is laid out and the rooms requiring continuous service should be kept as close together as possible. Fig. 5 is an example of the saving effected by the use of a 24-hr. main, which was installed in an office building to heat the lobby for the night watchman and to heat water for the janitors.

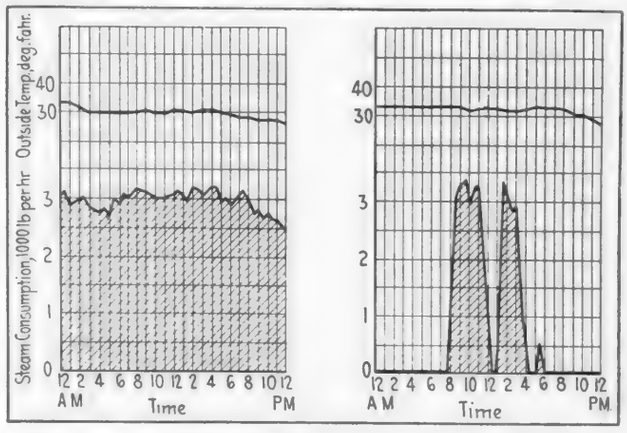


**Fig. 3. Load Curves Showing Savings Possible by Intermittent Operation**

Type of building—Department store
Radiation—26,500 sq. ft.
Steam consumption for day—72,000 lbs.
Mean outside temperature—31° F.
Mean wind velocity—W. 30.5
Steam consumption for day—20,000 lbs.
Mean outside temperature—31° F.
Mean wind velocity—W. 8.4

This installation, costing about $200, is making a saving of approximately $500 per month in cold weather.

### REMOTE-CONTROLLED VALVES

In many buildings having a number of central heat consumers, each with a separate heating system, the service enters the basement of one store and is distributed from a header to the various other consumers. Naturally it is frequently impossible to give all the consumers access to the basement where the header is located. In such cases, remote-controlled valves can be used to advantage. These are of two types, *first*, those consisting of a quick-opening valve with a chain or cable for operating, and *second*, those which are operated electrically. The first class, using chain or cable, works quite satisfactorily for short and straight distances but the use of pulleys for turns in the line is generally a source of trouble. Good results have been obtained by the use of bell cranks in place of pulleys. The second class, electrically operated, has been worked out successfully by the use of a thermostat motor, controlled by a small double-throw switch instead of the thermostat.

### THERMOSTATIC CONTROL

In a final analysis, proper temperature control at all times is the key to economical operation of a central

heating system. The simplest form of control is that effected by manual operation of valves as has been described. There are also numerous devices on the market for mechanical control of building temperatures. For small buildings the unit thermostat method, in which the steam supply for the entire building is controlled by a single thermostat, is very satisfactory, especially with time attachment for lowering the temperature maintained during periods when the building is unoccupied. Fig. 6 shows characteristic operation and saving effected by unit thermostat control. Some manufacturers of thermostats claim that large buildings are being operated satisfactorily with unit control. While this method may not be impossible for large buildings, it is easy to conceive conditions under which satisfactory control might be difficult.

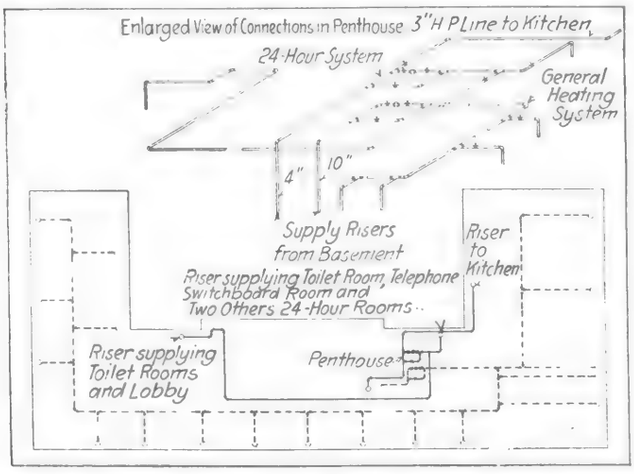
Enlarged View of Connections in Penthouse
3"H P Line to Kitchen
24-Hour System
General Heating System
10"
4"
Supply Risers from Basement
Riser to Kitchen
Riser supplying Toilet Room, Telephone Switchboard Room and Two Others 24-Hour Rooms
Riser supplying Toilet Rooms and Lobby
Penthouse

**Fig. 4. Arrangement of 24-hour Service Main Separate from the Main System**

In the larger buildings the ordinary method of individual control is most desirable in which a number of thermostats are installed in the building, each thermostat operating one or more radiators. However, with individual thermostat control using the "positive"-type thermostat in which the controlled valve is either wide open or tightly closed, perfect temperature regulation is difficult. When the temperature of the room reaches that set on the thermostat, the valve on the radiator closes. This radiator is still full of steam and the large weight of metal in the radiator itself is at a temperature between 212° and 230° F. and continues to radiate heat to the room. The occupant, becoming too warm, opens the window, thus cooling off the room sufficiently to cause the thermostat to open the radiator valve again.

An intermediate-type thermostat, which will open the radiator valve only to a degree required by the need for heat in the room, is much to be preferred, but the present commercial arrangements are not suitable. A very slight lift of an ordinary-size radiator valve is sufficient to fill a large radiator with steam, and the system then acts the same as with the "positive" thermostat. In one building under the author's observation in Detroit, orifice sleeves were installed in the radiator valves to restrict the flow of steam to the radiator and these, in conjunction with intermediate type thermostats, give good temperature regulation.

### VACUUM SYSTEMS

The installation of a vacuum pump on a heating system using central service is a desirable feature from the standpoint of economy of operation. One of the greatest assets of a vacuum system is the positive removal of air which guarantees quick circulation. This insures even distribution of heat throughout the building and permits the building to be brought up to the desired temperature in a minimum time after it has been allowed to cool down. The rapid heating of a building makes it possible to keep steam shut off for longer periods of time. Aside from these features it has been demonstrated by tests on several buildings in Detroit, that there is a decided saving effected by the use of vacuum pumps because of the increased flexibility of the system. In a straight steam system the temperature of the radiation cannot be varied to any great extent and usually the only means of temperature control is by operating the radiator valves, which is seldom done, and consequently the building is overheated much of the time. By the use of a vacuum system it is possible to vary the temperature of the steam in the radiators considerably, thereby varying the rate

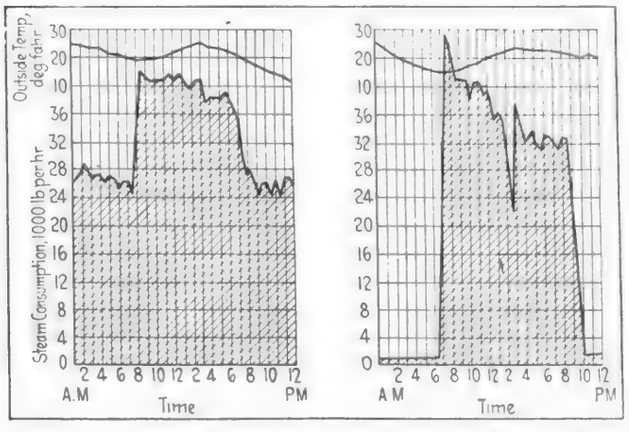


**Fig. 5. Load Curves Showing Savings Possible by Means of 24-Hour Main**

Type of building—Office bldg.
Radiation—12,600 sq. ft.
Steam consumption for day—78,300 lbs.
Mean outside temperature—20° F.
Mean wind velocity—S. W. 21.8
Steam consumption for day—50,475 lbs.
Mean outside temperature—20° F.
Mean wind velocity—N. W. 8.2

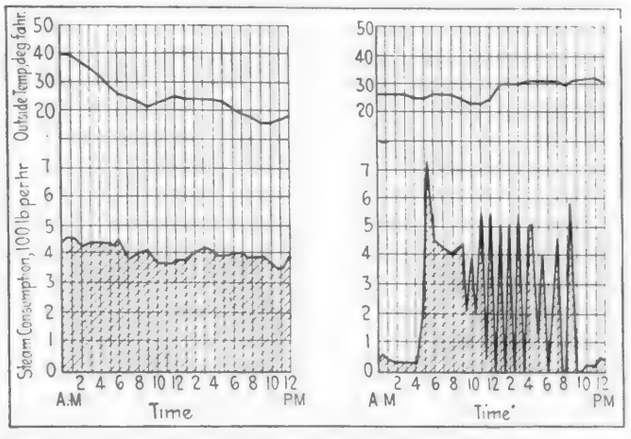


**Fig. 6. Load Curves Showing Savings Possible through "Unit" Thermostat Operation**

Type of building—Apartment building
Radiation—1220 sq. ft.
Steam consumption for day—9600 lbs.
Mean outside temperature—28° F.
Mean wind velocity—W. 21.2
Steam consumption for day—5100 lbs.
Mean outside temperature—28° F.
Mean wind velocity—W. 16.3

of heat transfer. The possible variation may be at least 30% from 230° F., corresponding to a steam pressure of 6 lbs. to 170° F., corresponding to a vacuum of 17 in.

To secure economy by the use of a vacuum system, proper maintenance of the system is absolutely essential. The system should never be allowed to get in such a condition as to make jet water necessary to condense steam and vapor in the return lines. Jet water is very undesirable and is unnecessary in a properly maintained system.

If the building engineer avails himself of the opportunity afforded by a vacuum system to regulate the temperature of the steam by varying the pressure, a considerable saving can be effected. The distribution mains of a heating system are usually in the attic or basement spaces which require little or no heat. Even though the piping is covered with ordinary covering there still is considerable heat loss from these mains. Reducing the temperature of the steam by varying the pressure reduces this loss. With a vacuum system considerably greater pressure drops through the system are possible with a low initial pressure and the size of the piping may be reduced, thus cutting down the cost of the installation and the radiating surface of the piping.

A vacuum system has some disadvantages which may be cited. The initial cost is greater than some other systems; it needs more attention than open systems; the maintenance cost is higher; and the desirability of duplicate pumps requires more floor space. Results of investigations seem to show, however, that these objections are of minor importance.

(The authors here gave figures of tests in two Detroit buildings to determine the economy effected by vacuum heating systems. The results of these tests were published in THE HEATING AND VENTILATING MAGAZINE for July, 1923).

### SALVAGING HEAT IN CONDENSATE

The heat of the liquid constitutes about 15% of the total heat of the steam used for heating buildings and there is little of it given up by the condensation in most types of heating systems. In many central heating systems where the condensate is not returned to the boiler plant but is permitted to go to the sewer before this heat is extracted, a considerable waste occurs. To utilize a portion of this otherwise wasted heat the installation of some sort of economizer is very desirable.

(The paper as presented included a description of various types of heating economizers, including an indirect air heater, a direct air heater, a water heater, together with performance data showing their usefulness).

### ATMOSPHERIC AND VAPOR SYSTEMS

In connection with the subject of salvaging heat from the condensate, atmospheric and vapor systems and installation of radiator traps are to be commended, as they eliminate steam from return lines and discharge the condensate to the sewer at a low temperature. The installation of modulating valves such as are generally used on atmospheric and vapor systems, however, does not seem to be of any particular advantage. While the valves are all right theoretically, an inspection of several hundred such valves on an average winter day disclosed 45% wide open, 50% closed and only 5% partially open. In other words, in only about 5% of the cases did the occupants actually take advantage of the regulating feature of the valve. The buildings investigated were stores and office buildings.

### DATA ON HEAT CONSUMPTION

In the course of the investigations conducted in connection with economical utilization of heat much valuable data of a general nature has been compiled. Fig. 7 shows the variation by months of steam consumption in

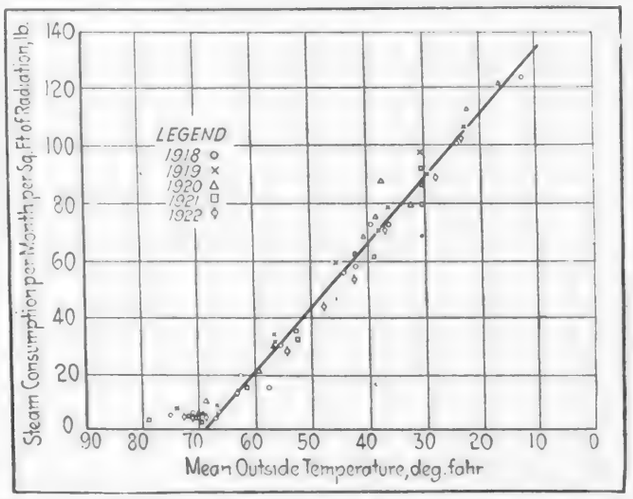


**Fig. 7. Chart for Estimating Steam Consumption in Various Types of Buildings, Based on Actual Results in Detroit**

Detroit by all classes of customers for various outside temperatures. Note that this is a straight line, showing that the consumption varies directly with the difference between inside and outside temperatures. It is an interesting point that the 1922 figures all fall below the line, as it was in 1921–22 when an intensive educational campaign was undertaken.

As the curve in Fig. 7 is a general average for all types and sizes of buildings, factors were computed from a study of 173 Detroit buildings, each having over 4000 sq. ft. of radiation. These factors take into consideration the required inside temperatures and hours of use for various types of buildings. To estimate the probable steam consumption in any particular building the reading on Fig. 7 should be multiplied by the factor for buildings of its type as given in Table 1.

TABLE 1. FACTORS TO BE APPLIED TO STEAM CONSUMPTION CURVE FOR VARIOUS TYPES OF BUILDINGS

| | | |
|---|---|---|
| Hotels | Average of 13 buildings | 1.35 |
| Public Buildings | Average of 4 buildings | 1.24 |
| Garages | Average of 4 buildings | 1.24 |
| Wholesale Houses | Average of 3 buildings | 1.24 |
| Printing Houses | Average of 6 buildings | 1.22 |
| Office Buildings | Average of 34 buildings | 1.04 |
| School Buildings | Average of 4 buildings | 1.94 |
| Auto Sales and Service Bldgs. | Average of 4 buildings | .91 |
| Loft Buildings | Average of 6 buildings | .87 |
| Clubs | Average of 5 buildings | .79 |
| Stores | Average of 29 buildings | .79 |
| Warehouses | Average of 4 buildings | .75 |
| Banks | Average of 9 buildings | .67 |
| Theatres | Average of 13 buildings | .48 |
| Churches | Average of 6 buildings | .44 |
| Dance Halls | Average of 3 buildings | .39 |

# Back To First Principles

## Plain Answers to Direct Questions on Present-Day Heating and Ventilating Practice

*By T. W. Reynolds*

*(Continued from the January issue)*

13. Q. How may a steam heating system be made tight so as to prevent the re-entry of air?

A. By using packless radiator valves, though ordinary radiator valves if properly repacked will help, the valves being repacked, whether old or new, so as to prevent all air leaks through the stem stuffing box.

Discs and seats of the water-column gauge cocks should also be gone over, so as to make an air tight joint when closed and the try-cocks at the bottom of the water column and water gauge should be tightened. Also, if there are any bubbles rising through the water in the gauge glass, look for a leak in the lower packing nut, or gauge glass try-cock.

On new work, pipe joints should be carefully made tight and fittings examined, before use, for sandholes and other defects. Painting all pipe lines with a good quality of black asphaltum will prevent slight leaks in the pipe and fittings due to the porosity of iron.

Sometimes on new work, while the system is being operated for the first few weeks, pet cocks are installed temporarily for air relief. Then, after the radiators and piping are rid of the usual dirt, scale, red lead and other substances present in new installations, the pet cocks are replaced by permanent air valves of the usual type.

After the system is made tight, fire should be started in the boiler and pressure raised for testing purposes to about 10 lbs. and maintained at this point until all radiators are fully vented and all pipe and radiating surfaces hot. Meanwhile, pipe joints should be examined for steam leaks, as indicated by slight vapor or by hissing. If everything is found satisfactory, the fire may be dumped and windows opened in order to quickly create a vacuum in the system. Then, when the system is cold, the vacuum gauge should show at least 15 in., with a loss of not over 1 in. every two hours; otherwise the job is not tight.

14. Q. If a steam heating system equipped with combined air and vacuum valves is tested and known to be tight at all points, and the air supposedly driven out, will some air still be expelled at air valves?

A. Sometimes, at remote intervals there will be a slight discharge from an air valve, but such discharges are probably gases arising from the decomposition of vegetable matter contained in the water.

15. Q. What advantages are derived by the use of automatic combined air and vacuum valves?

A. A system equipped with ordinary two-way valves is open through the valves to the atmosphere, consequently, steam cannot be circulated at a temperature lower than that corresponding to atmospheric pressure, as any vacuum produced in a radiator by condensation at a greater rate than the amount of steam supplied will be broken by the return of air at atmospheric pressure through the air valves. But a system in which the radiators are equipped with combined air and vacuum valves and otherwise sealed so that no air can enter (except by leakage after a number of hours), and from which the air has been driven, can be operated for a time at the temperature corresponding to the vacuum produced by banking or checking the fire. Of course, air gradually re-entering the system at various points (even though the job is practically tight) will decrease the amount of vacuum, so that after a lapse of time, depending upon the tightness of the system, pressure must be raised and maintained long enough to expel the air. After this has been done, the system may again be operated under vacuum conditions with steam circulating to all radiators at the lower boiling point of water under vacuum, for example (the boiling point of water at 10 in. of vacuum is 193°). Economical operation is then obtained, especially in moderate weather, because of the lower temperature of radiating surfaces.

In considering the above, it should be remembered that in any heating system properly designed, the amount of radiation installed is made sufficient to heat the rooms in coldest weather when the radiators are supplied with steam at a certain temperature. Consequently, in moderate weather, the radiators will give off more heat than is required unless the rate of combustion is retarded by banking or checking the fire. But, if this is done and the system is not sealed, the nearer radiators will condense all of the steam while the farther radiators will remain cold, as there is not enough steam supplied to go around. This results in unequal distribution, certain rooms being overheated, others underheated, so that neither economy or satisfactory heating is obtained.

To make this clearer, assume a steam heating system designed to heat a building to 70° F. when the outside temperature is 0° F. and the steam pressure 2 lbs. gauge (16.7 lb. absolute), the radiation installed for this purpose being direct cast-iron of the two-column type, 38 in. high, in units of 10 sections each. As the temperature of the steam is 219°, the temperature difference is 219—70=149°, for which difference the heat units transmitted hourly per square foot of radiation of the kind and size assumed is 249 (See tables in the A. S. H. & V. E. Guide). Then, if the hourly heat loss from the building at 0° F. is 697,200 B. T. U., the square feet of radiating surface required to transmit and make up

**Although many of the topics presented in this department will be familiar, no doubt, to our readers, we dare say their discussion from the standpoint of the principles involved, will be found interesting reading and may help to refresh the memories of many who have taken things for granted when it came to the operation of a given apparatus or appliance. Even the more experienced engineers, it is hoped, will at times find suggestions here which will be of practical value to them.**

**So far as possible, the questions and answers are arranged in logical order. The form adopted of question and answer will serve as a ready reference for the numerous details encountered in the design and construction of heating and ventilating systems.**

for this heat loss will be 697,200÷249=2800.

If the outside temperature rises to 25°, the difference in temperature between outdoors and indoors being 70—25=45°, the heat loss will be reduced to 45/70× 697,200=448,200 B. T. U., consequently, the rate of heat transmission should be reduced to 45/70×249= 160 B. T. U. According to tables in the A. S. H. & V. E. Guide the radiation will transmit heat at this rate if the temperature of the steam is lowered to 170°, the temperature of steam under a vacuum of 15.3 in. (6 lbs. absolute pressure). Accordingly, if the system is sealed, the fire in the boiler may be checked until the absolute pressure lowers to 6 lbs. This will reduce the number of heat units as supplied by the boiler (to suit the rise in outside temperature) to 448,200 B. T. U., which figure should equal the heat given off by the radiation in accordance with reduced heat requirements, thus, 160×2800 =448,200 B. T. U.

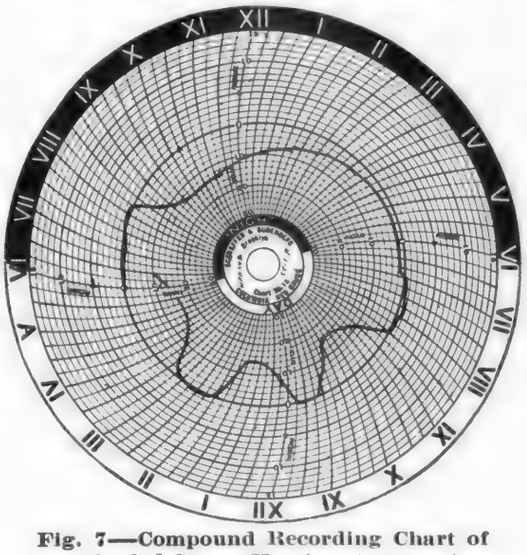

**Fig. 7—Compound Recording Chart of Sealed Steam Heating System.**

This can not be done in a system not sealed, as air at atmospheric pressure will enter through the air valves when pressure is lowered by checking the fire, and, as it is desired to heat the full amount of radiation, this air must be driven out through the air valves against atmospheric pressure. To accomplish this, the steam pressure must be raised slightly above that of the atmosphere, say ¼ lb. gauge, in order to overcome the friction (pressure drop) to the flow of steam through pipe and fittings, as well as supply the energy required to compress the air and drive it from the system.

From this it will be apparent that if air is to be prevented from entering the unsealed system, the steam pressure must vary from ¼ lb. gauge at the boiler to 0 lb. gauge at the farthest points of the system. Consequently, as the temperature of steam at the radiating surfaces will range from 213° to 212°, the average rate of heat transmission per square foot of surface cannot be less than 235 B. T. U., or the total heat transmission less than 235×2800=658,000 B. T. U. If the fire is checked, in order to reduce the heat transmission of the radiation to 448,200, as shown to be desirable at an outside temperature of 25°, the heat transmission must be reduced to 448,200÷658,000=68%. In other words, that percentage of radiation would be supplied with steam, varying in pressure from ¼ lb. gauge at the boiler, to 0 lb. gauge at points in the system where the radiating surfaces already passed by the steam have condensed the full amount of steam supplied. All points beyond would be air-bound and cold. Therefore, to obtain satisfactory heating in the unsealed system, the rate of combustion will have to be increased and the pressure raised in order to expel the air against atmospheric pressure and so heat the farther radiators. Consequently, more coal will be burned in the unsealed system. Also, more attention will have to be given to draft regulation and the system will be less responsive, as the air will frequently have to be driven out before heating can take place.

The charts in Figs. 7-8 show the difference in operation between the two systems and the savings possible in the sealed system. These charts are records obtained from a heating system in an apartment house in Newark,

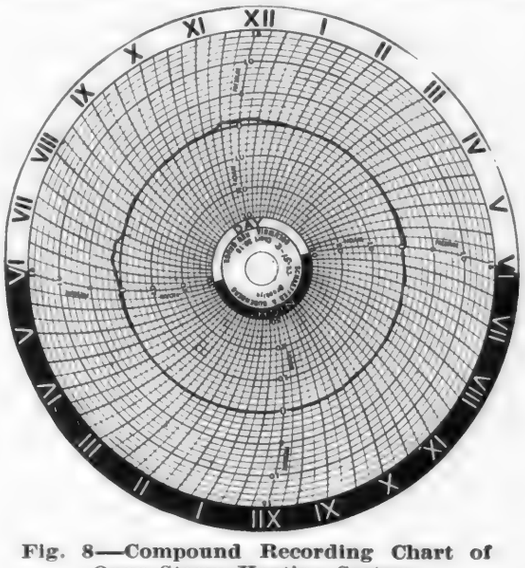

**Fig. 8—Compound Recording Chart of Open Steam Heating System.**

N. J. The system was sealed on one day and opened the next, average outside temperature being 38° and 48°, respectively.

Referring to the chart (Fig. 7) for the sealed system, steam was circulated at the inches of vacuum or absolute pressures shown, usually below atmospheric, and therefore the temperatures of the radiating surfaces were low. Whenever the curve rises toward the atmospheric line, it either represents air infiltration (as would take place in time under continued vacuum) causing the radiators to cool, or else rise in pressure causing the radiators to be hot.

Referring to the chart (Fig. 8) for the open system, wherever pressure lowered to the atmospheric line, because of decreased rate of combustion, the radiators soon cooled, as steam at pressures below atmosphere cannot circulate in an open system.

**New Secretary of the A. S. H. & V. E.**—Announcement has been made of the election as secretary of the American Society of Heating and Ventilating Engineers of F. C. Houghten, since 1920 a member of the society's Research Laboratory staff in Pittsburgh. Mr. Houghten has had active charge of some of the most important investigations conducted at the Laboratory, many of which have been described by him in papers presented to the society. He entered upon his new duties early in February.

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THERE is to be no abandonment of the work of the A. S. H. & V. E. Research Laboratory. That was made clear to all when the subject had its airing at the recent annual meeting of the heating engineers. We know now that there was less danger of its being abandoned than its warmest friends feared. It is true there has been a certain lukewarm interest in the work on the part of a considerable number of its supporters. The feeling was widespread that somehow or other the Research Laboratory was not turning out exactly in accordance with their preconceived ideas. No one questioned the fine quality of the work it was doing, but the rank and file of its supporters were more and more asking themselves just how it fitted in with their own practice and, to put it bluntly, just what they were getting out of it.

The situation was well expressed in the statement that the members possibly were being "fed up" on theory and were missing the practical type of papers which characterized the earlier meetings of the society. It was thought possible that the pendulum was swinging back again to a more practical view of the profession's needs in the way of data and research.

Such was the state of affairs when the thunderbolt from the blue, as it were, was hurled into the meeting in the form of a proposal to abandon the Research Laboratory. Perhaps it was necessary to take this course to awaken the Laboratory's supporters from their lethargy; at any rate, it served its purpose. It was intended as a challenge and such was its effect. Instantly it fanned into flame the underlying pride which all have felt in the Laboratory and brought home the realization that the Research Laboratory has taken a deeper hold upon the imagination than anyone had realized. So it happened that the sentiment of the members rapidly crystallized into a genuine rally to the Laboratory's support and long before the final vote was taken it was clear that the Laboratory, so far from being in danger of extinction, was about to receive a new lease of life.

FROM a practical standpoint, however, there was and is good reason for the feeling that an undertaking so ambitious as a heating and ventilating research laboratory is of much wider scope than that of any individual association. The work it is doing is one that is as far-reaching as humanity itself and if the laboratory had done nothing more than to formulate a true vision of what heating and ventilation means to the race, it would have justified its existence. It was probably this thought that brought such a warm response to the suggestion that steps be taken to secure an endowment for the Laboratory on a scale that would establish it permanently among the great institutions of its kind. As this idea developed, its supporters were not balked at the idea of a million dollar endowment and before the discussion ended such a project was actually launched.

IN THE meantime, a step of the utmost significance was taken in altering the basis upon which the Research Laboratory is conducted. A resolution was adopted in accordance with which it will now be possible for manufacturers, as well as associations and similar bodies, to have tests conducted of particular apparatus and appliances, the results to be published by the society. This new policy, which, we may state, is one which has always been favored by THE HEATING AND VENTILATING MAGAZINE, will not only provide a service of the most practical value, but will furnish the very thing in the way of practical data which so many of the Research Laboratory's supporters are demanding. Those who have feared to take this step will be reassured to know that the practice is one which has been followed for years by institutions of such standing as the U. S. Bureau of Mines and the U. S. Bureau of Standards, to say nothing of the many universities which have experimental facilities. In addition, two things in themselves have paved the way towards a successful operation of the Research Laboratory on the new basis. One is the unquestioned prestige which the Laboratory has attained as a result of its five years of achievement, and the other is the character of the safeguards which have been thrown around the proposed tests to insure their reliability and accuracy.

NOW that the proposed A. S. H. & V. E. Code on Heating and Ventilation has been drafted, it is possible to estimate the far-reaching effect it will have on the industry, if adopted in anything like its present form. For the code provides not only for the design of heating and ventilating systems, but for their maintenance as well. It is proposed to test all installations in accordance with the Synthetic Air Chart, and the minimum score in such a test is put at 85%. One has only to imagine the code in effect in a few of the larger States to realize that it will call for more engineering talent than is to be found at present in the entire profession.

# Future of Research Laboratory and Proposed Code on Heating and Ventilation Take First Place at Heating Engineers' Convention

IF a bombshell had been thrown into the annual meeting of the American Society of Heating and Ventilating Engineers, at the Hotel Pennsylvania, New York, January 22-25, it could hardly have created a greater sensation than the proposal made at one of its sessions, by a member of the society's Committee on Research, that the A. S. H. & V. E. Research Laboratory in Pittsburgh be abandoned. The proposal came in connection with the discussion of the report of the Committee on Research in which it was made very clear that the present funds on hand were not sufficient to permit the Laboratory to continue beyond a few more months. The seconding of the resolution by another member of the Committee on Research was all that was needed to provide a genuine shock which ran through the room like an electric spark.

After a tense pause a dozen members sprang to their feet and the chair was kept busy recognizing those eager to have their say. When the first flush of excitement had subsided, the meeting settled down to an earnest and extended discussion of the status of the Research Laboratory, its achievements, as well as those things in which some felt it had not fully met the expectations of its supporters. Perhaps the point most clearly brought out was that the Research Laboratory could not possibly realize its purpose unless it received a more whole-hearted

## New Basis of Operation of the A. S. H. & V. E. Research Laboratory

Following is the full text of the resolution offered by the Committee on Research of the American Society of Heating and Ventilating Engineers, and adopted by the society, at its annual meeting in New York, January 24:

Resolved,

1. That the resolution submitted by the Research Committee at its meeting of March 10, 1919, in which appears this paragraph, "It is the sense of the committee that no tests, experiments or research shall be conducted for compensation" be rescinded.

2. (a). That the society raise sufficient monies to pay the overhead of the Research Laboratory, such as salaries of the Director and his clerical or stenographic force, traveling expenses and stationery supplies.

(b). That each chapter of the society be requested to be responsible for raising an amount equivalent to $10.00 for each member of the chapter each year. That is, each member is to give or get $10.00 towards this fund. Those in the chapter capable of giving more than $10.00 can make up for the members who might not be able to contribute so much or at all. This fund is to be used for overhead and for fundamental research.

3. That fundamental research paid for out of monies raised as described in Section 2b are to be undertaken only on such subjects as are of vital interest to the members of our society or the general public.

4. That any research may be undertaken for other engineering, scientific, technical organizations, trade associations, manufacturers' associations, persons, firms or corporations, provided all work shall be related to the science of heating and ventilating and of such character as to meet with the approval of the Research Committee, and that only those subjects may be investigated for which sufficient funds to pay all costs thereof have been assured.

5. That the testing of apparatus may only be made upon request or authorization of manufacturers thereof and shall be conducted under the following conditions:

(a) That the Research Committee shall sanction each test before being made and approve the testing code to be used.

(b) That the manufacturer shall pay all costs to the Laboratory, such as the salaries of investigators, materials, supplies, labor, expenses and overhead.

(c) That the manufacturer shall keep on deposit with the treasurer of the society an amount equal to the estimated cost of the work for not less than two months in advance against which account the costs will be charged.

(d) The manufacturer shall be advised of the progress of the test and shall have the privilege of discontinuing it at any time upon giving a ten day's written notice, and the paying of all costs, including salaries of the investigators to the end of the month following such notice.

(e) That the result of the test, without comment, may be authorized for publication in the Journal by the Research Committee.

(f) That the manufacturer shall not publish or allow to be published, in whole or in part, the report of the test until after publication in the Journal of the society or by authority of the Research Committee.

(g) That the apparatus tested shall be removed from the Laboratory by the manufacturer promptly upon the completion of the test.

(h) That the manufacturer shall give a bond or other security approved by the Research Executive Committee guaranteeing to the society the full performance of the contract on the part of the manufacturer.

6. That a technical sub-committee shall be appointed for specific projects or tests upon which the Laboratory is working before such test is begun and shall act in a consulting capacity, and that these sub-committees shall submit all recommendations and criticisms in writing to the Research Executive Committee.

7. That the chairmen of all technical sub-committees shall be associate members of the Research Committee and shall be invited to attend and take part in the deliberations of the Research Committee, but shall have no vote therein.

support on the part of the individual members of the society.

The discussion became so prolonged that it was necessary to carry it along to another session. When finally a vote was taken on the proposed resolution, it was voted down with a resounding "No" that echoed down the corridors.

**J. Irvine Lyle, for the Committee on Research** then presented the resolution printed in full on the preceding page. This resolution was also discussed at length and was finally adopted in the form proposed.

The other outstanding feature of the meeting was the presentation of a proposed Code on Heating and Ventilation, prepared by a committee headed by Louis P. Harding, of Buffalo. This report proved a monumental undertaking and practically a whole day was given over to it. As was stated by President Gant, the report was not presented for adoption but only for comment. The suggestions and criticisms will all be taken into consideration by the committee and it is hoped that the proposed code can be whipped into shape for final action possibly at the society's next semi-annual meeting.

The attendance was excellent, the registration showing a total of 389 members and guests.

## Opening Session, January 22

After opening the meeting, President H. P. Gant presented his address in which he declared his belief that the history of the society would date from the compilation of the Code on Heating and Ventilation which is in preparation under the general direction of Louis P. Harding.

We frequently hear, he said, that a commercial element is entering into the activities of our technical societies. He felt, however, that the society is on a far more ethical plane that it has ever been in the past and that the vast majority of its members are not seeking self-advancement, but are rather considering their work from the broader standpoint of its ultimate effect on humanity.

"In our profession," he said, "most of us are so intent on the details of engineering that our analytical minds lose sight of the fact that every time we definitely determine a new coefficient of heat transfer or a critical velocity in a pipe, we have possibly shown future generations how to conserve a pound of coal or a pound of steel, and this conservation, made possible through increased knowledge, is cumulative."

Speaking of the society's Research Laboratory, President Gant, after paying a tribute to its achievements, stated that "during the past few years there have been many urgent requests from various technical societies, trade associations and business organizations for the Laboratory to conduct specific tests for compensation.

"The policy of the Research Committee has, in the past, been against accepting fees for specific work, but depend upon voluntary subscriptions to support the work of the Laboratory. The Research Committee and the council now feel, however, that it is time to make a change in this policy, and your president recommends that the society approve the plan which will be laid before you by the Research Committee, feeling that this plan can be adopted with due propriety and the work can be conducted in an ethical manner without adverse reflections upon the work of the Laboratory."

Later on in the meeting this suggestion was acted on favorably.

Mr. Gant expressed his gratification that the *Guide* of the A. S. H. & V. E. for 1923, not only surpassed the *Guide* for 1922 in appearance, augmented data section and catalog section, but it showed an excellent financial return of some $7,000. He mentioned J. Esten Bolling and A. V. Hutchinson as entitled to the thanks of the society for their work on the *Guide*.

In commenting upon the report on the New York State Commission on Ventilation, prepared by Chairman C. L. Riley, President Gant expressed the hope that the discussion on the report would clear the atmosphere to a better understanding of the proper principles underlying satisfactory ventilation in public buildings.

During the year, he said, 321 new members were elected, being an increase of 36% over the number elected in 1922.

President Gant expressed his regret over the resignation of Secretary C. W. Obert who, he declared, deserves much credit for the growth and accomplishments of the society. He declared that Mr. Obert's good work would be felt in the years to come.

In closing President Gant said he wished to leave the thought of service which, he said, has been the underlying *motif* of the present administration.

### REPORT OF COUNCIL

The council, in its report, called attention to the reestablishment of the society on a sound financial basis. The new Code on Heating and Ventilation, it was stated, is one of the greatest opportunities for service which has been offered the society. The report referred to the establishment of the *Journal* as a monthly publication. The 1923 *Guide*, it was stated, has been well received, and indications are that the 1924 *Guide* will be an even better number.

### SECRETARY'S REPORT

Secretary C. W. Obert, at the opening of his report, expressed his regret at leaving the society after a service as secretary of seven years. He spoke of the remarkable expansion of the society, referring particularly to its service to the government during the world war and its present enlarged service to mankind.

He felt that the society was fulfilling the ideal of working for the best interests of the engineering profession rather than to promote individual interests. Engineers, he declared, must be represented in public work.

The chapters of the society, he said, are the natural feeders to the society of new members and he urged better headquarters organization to serve the chapters, especially in such ways as securing speakers. The activities of the society's technical committees, he said, are greater than in any other society, when its size is considered.

Homer Addams reported for the Executive Committee, paying a tribute to the devoted service of its members.

### SOCIETY SHOWN TO BE IN PROSPEROUS CONDITION

For the Finance Committee, Chairman Thornton Lewis reported the society to be in the best financial

position it has enjoyed in years. The receipts not only exceeded the budget by some $1500, but the expenses came to $1500 less than estimated, making a total saving on the year's operations of $9000. The treasury now has $21,000 in the general fund and $7626 in the Research fund. For the first time the initiation fees, amounting to $3100, have been set aside as a reserve fund, and it is proposed to continue this practice.

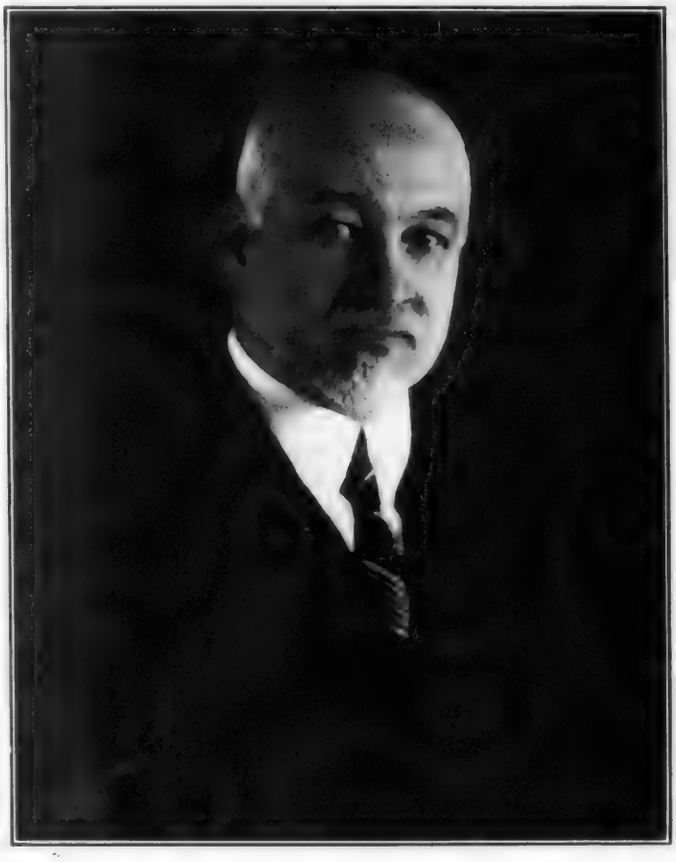
The report of the Publication Committee, was read by A. V. Hutchinson. The report stated that the *Guide* had been sent to all members of the American Institute of Architects and members of the Heating and Piping Contractors' National Association, as well as to the society members. The total income from the society's publication in 1923 was $29,000, as compared with $24,000 in 1922.

### BOILER TESTING CODE ADOPTED

Favorable action was taken on the Report of the Committee on Code for Testing Low-Pressure Heating Boilers, the final draft of the code being adopted by unanimous vote.

Homer Addams expressed the opinion that the code would become a standard, but felt that the committee should be continued to interpret the code.

Thornton Lewis stated that the Code will greatly help the work of the Research Laboratory in furnishing a basis on which to make boiler tests.



**Homer Addams,**
President, American Society of Heating and Ventilating Engineers.

This report gave the following as the essentials necessary to determine the heat efficiency of a steam heating boiler:

(a) Total heat input; (b) total heat recovered at the boiler outlet.

The code covers such items as preparation for test, apparatus and instruments, duration of test, method of starting and stopping test, method of firing and fuel sampling. This is followed by a standard form for reporting results of low-pressure steam heating boiler tests, accompanied by log sheets.

The principle results to be sought in a test were given as:

Heat recovered at the boiler outlet per hour, in 1000 B.T.U.
Maker's rating (sq. ft. radiation x 240), in 1000 B.T.U. per hr.
Percentage of maker's rating developed in per cent.
Mean interval between charging fuel in hours.
Mean interval between attention of any kind to the fire, including charging in hours.
Overall thermal efficiency, in per cent.

For the Committee to confer with the American Institute of Architects, Stewart A. Jellett said that a meeting had been arranged for during the week of the society's meeting and that he might have something to report at a later session.

### COMPARATIVE TESTS OF SCHOOL BUILDINGS EQUIPPED WITH WINDOW VENTILATION AND RECIRCULATION SYSTEMS

An important announcement was made by Frederic Irving Cooper, in connection with his report for the Committee on Schoolhouse Standards when he stated that two large school buildings are now being built in Hartford, Conn., of similar appearance and construction, one of which will be equipped with the Wheeler system of window ventilation and the other with a recirculating system. The window-ventilated building plans were sent out for alternate bids and the cost of the window-ventilated building was found to be $32,000 less than that of the same building providing for air recirculation. The total estimated cost of the building is $1,500,000. The equipments in both of the school buildings referred to were designed by the same engineer, C. W. Kimball, of Boston, and both systems are being installed by members of the society, the window-ventilating system by Bain of Boston and the air-recirculation system by Libby & Blinn, of Hartford.

Among other things it was found that where three boilers were provided for in the building using recirculated air, in the window-ventilated building four boilers were necessary. Fortunately the chairman of the Building Committee, Dr. Naylor, is a physician of note and is interested in promoting the idea of conducting tests in each building.

Mr. Cooper spoke of the tests made in the Oliver Wendell Holmes School in Boston, and of the proposed extensive ventilating tests in Denver. He said it was now necessary to determine how tests should be made on window-ventilated schools to secure the desired data. In the discussion it was stated that the Synthetic Air Chart would apply to such a test.

Regarding the proposed Code on Heating and Ventilation Mr. Cooper said Massachusetts and Ohio are both considering revisions of their codes, so that the adoption of a suitable code by the society would be especially timely.

On motion of George B. Nichols the committee was requested to prepare a preliminary report giving the design and cost of the two Hartford school buildings.

### Afternoon Session, January 22

At the opening of the afternoon session, Chairman T. H. Ireland of the Teller's Committee announced the following results of the ballot for officers for the ensuing year:

President: Homer Addams, New York.

First Vice-President: S. E. Dibble, Pittsburgh, Pa.

Second Vice-President: William H. Driscoll, New York.

Treasurer: Perry West, New York.

Members of the Council: F. Paul Anderson, Pittsburgh.

Willis H. Carrier, Newark, N. J.

Joseph A. Cutler, Chicago.

H. P. Gant, Philadelphia.

Walter E. Gillham, Kansas City, Mo.

L. A. Harding, Buffalo, N. Y.

Alfred S. Kellogg, Boston, Mass.

Thornton Lewis, Philadelphia.

Members of the Committee on Research: Homer Addams, E. Vernon Hill, Alfred Kellogg, J. R. McColl, F. R. Still.

The first professional paper was presented by A. M. Feldman on "Problems in Ventilation of Department Stores."

### Problems in Ventilation of Department Stores

Mr. Feldman described a practice which he had developed for the ground floors of large department stores so as not only to provide an ample supply of fresh air large enough for an unlimited number of customers and sales force, but also to eliminate all danger of drafts, due to the inrush of cold air through entrance doors. In his design the ventilating system is so arranged that the fresh air supply is greater than the exhaust. More air is being delivered throughout the first floor than is taken out by the exhaust fan. The excess of air has to escape through the elevator shafts and entrance doors. Therefore, when the latter are opened, the warm air from the store escapes thus practically giving a warm greeting to the prospective customers. No draughts of cold air are rushing in on the sales force who are thereby in a better physical condition to give full attention to the customers.

In addition to this, the design includes the blowing in of re-heated air through registers in the ends of the counters at the doors, and also under the show windows just outside of the entrance doors. Notwithstanding the absence of outside doors in the spaces between the show windows the atmosphere around the entrances is kept comfortably warm and pleasant.

In discussing this paper Stewart A. Jellett stated that under ordinary conditions no exhaust fans are needed in basement ventilation, as the air will naturally be drawn out at various points.

A. M. Goodloe presented a paper on "Determining the Efficiency of Air Cleaners" in which he described a novel apparatus for measuring the efficiency of air filters in eliminating dust.

A paper by Arthur T. North followed on "Air Handling and Humidity Problems in Wisconsin Paper Mill." This installation was described by Mr. North as a clever method of handling air in such work. There is no steam evaporated for humidifying and the humidity in the drying zone is under complete control and can be brought to any desired percentage by manipulating dampers in the ducts entering the fan room, through which air is brought from the different parts of the mill and from out of doors. The entire mill, except that part adjacent to the railroad tracks, is in one room and there are five different temperatures and humidities maintained therein from one source of supply.

The temperatures outside of the drying zone are controlled by manipulating the dampers in the outlets in the floor. By this means the flow of air is controlled at will. Hand control is used. The humidity is regulated by the admission of fresh outdoor air into the fan room in such quantities as may be required. No artificial means of humidifying the air by water, steam or vapor is used. It is done entirely by controlling the admission of outside air. The air in the mill is continuously recirculated.

The session concluded with a paper by L. P. Hynes on "The Place of Electricity in the General Heating Field.

### The Place of Electricity in the General Heating Field

In this paper Mr. Hynes pointed out the advantages of electric heat for certain classes of work and emphasized the point that heating engineers must give increasing consideration to electric heating.

Where electric current, he said, can be secured for 2c. per kilowatt hour, it can be used for special applications, but where it can be obtained for 1c or less per K.W.-hr. it can be quite widely used. This is especially true where the climate is relatively mild, and the periods when heat is needed are of short duration or very intermittent. Also where good grades of fuel are expensive or hard to obtain.

In comparing fuel costs, the following data were offered by Mr. Hynes:

1 K. W.-hr. of electricity=3415 B. T. U. all effective.

1 lb. coal having 13,000 B. T. U. when used in a heating system at 50% efficiency=6500 B. T. U. effective.

1 cu. ft. city gas having 550 B. T. U. when used in a heating system at 75% efficiency=412 B. T. U. effective.

1 lb. oil having 18,500 B. T. U. when used in a heating system at 70% efficiency=12,950 B. T. U. effective.

The above fuels are equal in cost when the cost of 1 K.W.-hr. of electricity equals in cost 0.53 lb. of coal,

(*Continued on Page 79*)

# Who's Who In Heating and Ventilation

## 1—S. Homer Woodbridge

S. Homer Woodbridge

WHILE attending the Massachusetts Institute of Technology as a student in Department of Physics, intending to prepare himself as an instructor, S. Homer Woodbridge, then a young man, became practically interested in matters of ventilation because of the atmospheric conditions existing in the crowded class and lecture-rooms, manifestly detrimental to the work of both instructors and students.

Through his efforts and under his supervision, such simple, inexpensive and effective means for ventilation were provided for the relief of many of those rooms that, when the large lecture, laboratory and classroom "Walker Building" was planned, he was directed by the corporation building committee to prepare plants for its ventilation, Frederick Tudor being retained at his solicitation as associate in a consulting and contracting capacity on the side of heating.

When the proposed scheme was submitted to a couple of the leading firms in the steam-heating trade in Boston for an opinion as to the practicability of the plans, the trend of advice was to the effect that the installation of such a plant would cost a mint of money, and that its operation would require a mine of coal. The advice of Harvard University, after a disappointing experience at Sever Hall, was emphatically adverse to an adoption of the plan. The committee, however, backed its own student product, with the result that the building equipment and the performance of its system in both efficiency and economy became widely and favorably known, both at home and abroad.

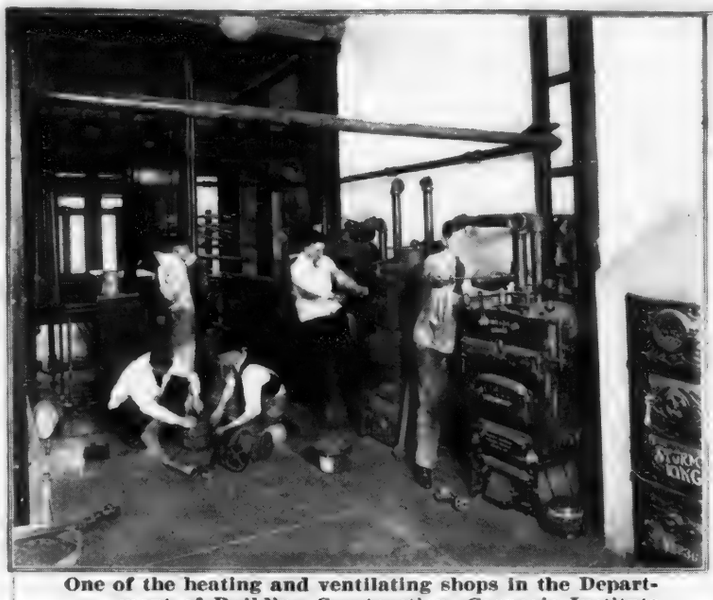
Following that result Mr. Woodbridge was directed by the corporation to devote his entire time to the work of transforming the then capricious art and rule-of thumb practice of heating and ventilation into an established science. By that act he was diverted from his pre-conceived purpose of devoting his life to the acquisition and teaching of a pure science, and became a pioneer in this country in the modern technically-established theory and practice of heating and ventilation; he became the first appointed instructor specialist in that department in American technical schools.

### VENTILATION A FRUITFUL FIELD FOR VAGARIES

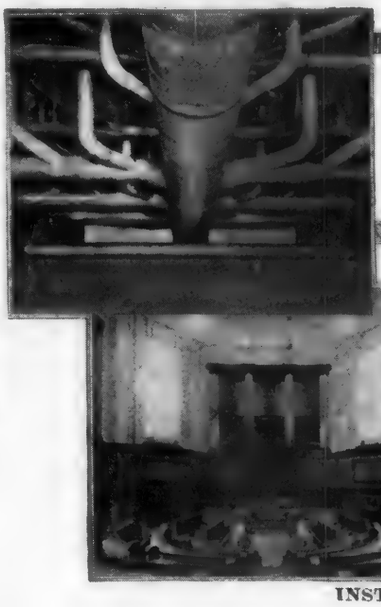
Early in his adopted professional career he became impressed with the vagaries then common in the practice of the art of ventilation, due, as it appeared to him, to too little and dangerous knowledge, and to untrained imagination and fantastic theories which too largely formed the basis of both the theory and practice of the "practical" men of that day to whom such work was commonly committed. He came to regard the situation as a logical consequence of the attempt of "practical" knowledge to deal with the invisible inherent in ventilation—air, atmospheric content of heat, moisture, ventilation, motion of air, courses of flow, forces producing flow, and so on. Because of the occultness of this whole realm of material, of movement, of force involved in ventilating problems, the field impressed him as a fertile one for the rank growth of fantasy, imagination, notion and all their various sporadic fruits.

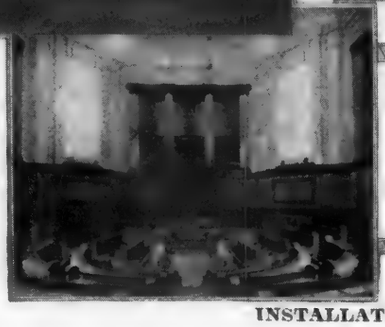
(*Continued on page 78*)

# Engineering Prog



One of the heating and ventilating shops in the Department of Building Construction, Carnegie Institute of Technology, Pittsburgh.





INSTALLATION DETAILS OF

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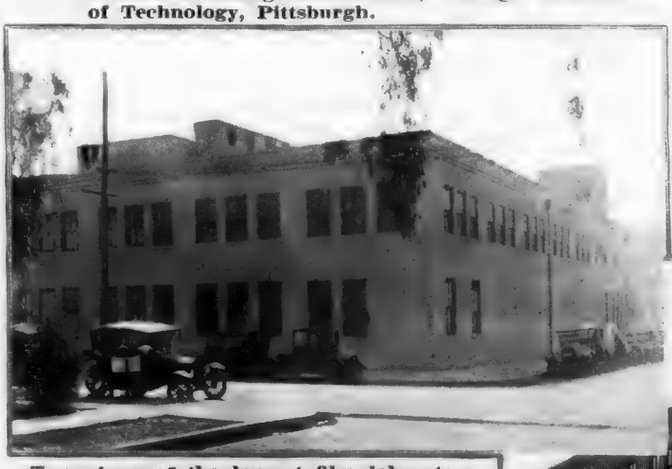
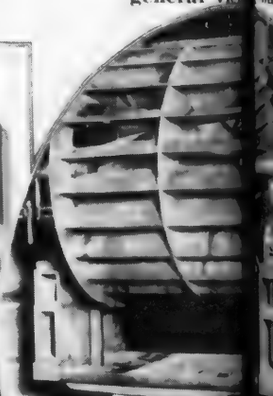
Council Chamber. (Above) The "Octopus" air distributing trunk line.





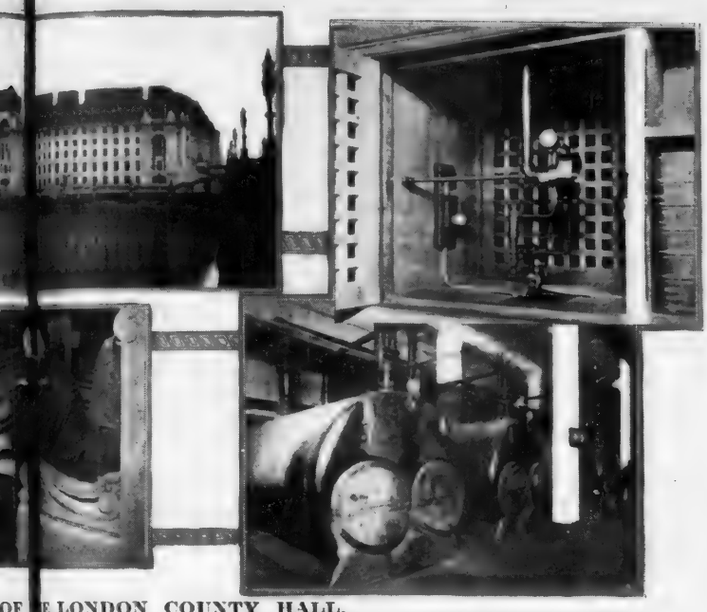
Two views of the largest film laboratory in the world, that of the Famous Players-Lasky Corporation, in Hollywood, Cal., whose heating and ventilating equipment were described in the December issue.

Method of filtering the air in the fan blast heating equipment at the plant of the Nucoa Butter Co., Bayonne, N. J.

Water filter installation connected with air washing equipment at plant of Famous Players-Lasky Corporation, Hollywood, Cal.

Dynamic bala
balancing

# rogress Illustrated



OF E LONDON COUNTY HALL.

for idual venti-
con (Above)
vie building.

Boiler room, showing unique type of heaters used (Above) Location of thermostat in council chamber.

Students of the Carnegie Institute of Technology at work in the sheet metal shop.

Type of casing construction for underground pipe conduit at University of Illinois, showing expansion joint in manhole.

(At left) Drying sausages on a large scale by means of air conditioning equipment.

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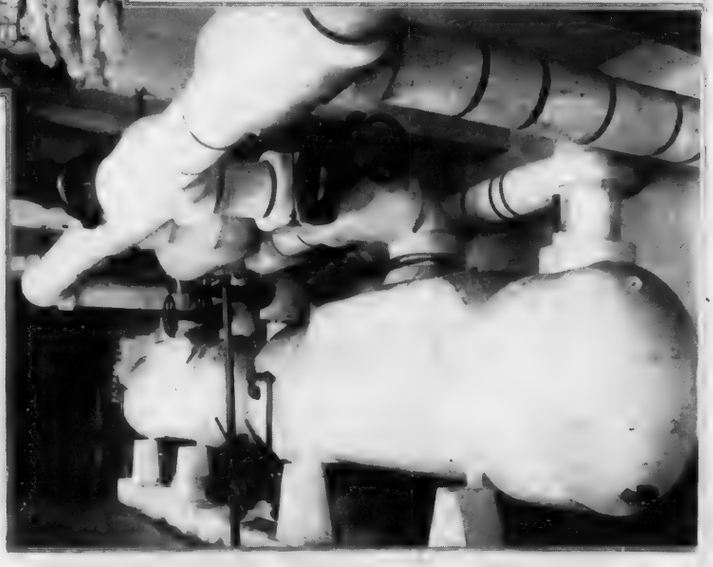
wheels.

View in the welding shop at the Carnegie Institute of Technology, Pittsburgh.



Typical Domestic Water Service Heater Installation at Remington Arms, Ilion, N. Y.

# Who's Who in Heating and Ventilation

(*Continued from page 75*)

### CONCEPTION OF AIR AS A MATERIAL SUBSTANCE

Mr. Woodbridge's endeavor with students, and also with co-workers, was primarily directed toward the creating and establishing of conceptions which accept the air as a material substance, subject to all the laws of mechanics and thermodynamics; as capable of being measured, weighed, soiled, cleansed, moistened, dried, heated, cooled, moved, and its motion directed not only within confining channels, but also in free space.

### UPWARD AND DOWNWARD VENTILATION

To the thermally-uninitiated his applied theory and practice appeared at times contradictory, as in his advocacy of both upward and downward ventilation; whereas consistency in choice of methods was always to be found in the oft-asserted principle that prevailing thermal conditions determined the appropriateness of method; namely, upward ventilation when the air passed through a chamber is warmed in its transit through the same, and downward ventilation when such air is cooled in transit.

In the case of those audience chambers in which the air is warmed in transit, and wherever the method is feasible, Mr. Woodbridge has advocated the admission of fresh air in the closest safe proximity to each breather, always in a draftless manner, and in minimum volume rate, equal to that which rises away from each breather in column form as the air is warmed, moistened, vitiated and lightened by contact with and exhalation from the breather, such volume rate being possible of increase to any maximum degree permissible and compatible with draft, atmospheric and economic.

### USE OF UNUSUAL EXPEDIENTS IN VENTILATING WORK

For the purpose of draftless supplying and diffusing the largest permissible quantity of air in special cases, resort has been made by Mr. Woodbridge to expedients not commonly found in ventilating work, such as utilizing the legs of chairs in theatres, lecture and music halls, where seats are permanent and fixed; the desks and floor risers in legislative halls; pew bodies and construction in churches. In one installation, for instance, which he designed for the New York Court House, the arrangement provided for a supply of air at the rate of 200 cu. ft. per minute per capita to the judges of the bench, while in the case of the equipment for the United States Supreme Court, the air is supplied through 6 to 8 sq. ft. of outside and porous covering of the several chairs, the quantity of flow being individually controlled by each chair occupant by an electrically-operated damper, and the temperature of the supplied air being similarly governed by an electric and personally controlled heater.

### IMPORTANCE OF "EFFICIENCY, ECONOMY AND SIMPLICITY" IN HEATING WORK

Though probably better known in the field of ventilation, than that of heating. Professor Woodbridge has shown independence of method and practice in the heating field. In both his teaching and practice he has always laid emphasis on "efficiency, economy and simplicity" in the order given. In both branches of work care has been taken to reject blanketing methods for covering all possible errors or computation, as well as to refuse self-committal through guarantees to produce satisfactory results in heating, unless the owner or builder guarantees the maximum rate of heat loss, and, therefore, the rate of heat supply. In matters of ventilation, also, satisfactory results have never been guaranteed beyond the supplying of given qualities of air, draftlessly distributed, and in accordance with provided plans and schedules. No responsibilities for results have been assumed, unless equipments for both heating and ventilating are operated in accordance with the letter and spirit of furnished directions, or by employees selected under approval and operating under his approval.

While teaching that heating is relatively imperative, and ventilation relatively expedient, Professor Woodbridge's rule, both in teaching and practice, has always been that the degree of ventilation should be the maximum compatible with draftlessness.

### DEVELOPMENT OF THE "FIXED ORIFICE" PRINCIPLE

His latest announced innovation in the engineering field is that set forth in the columns of THE HEATING AND VENTILATING MAGAZINE for January and March, 1921; namely, in the application of the principle of the fixed orifice, together with variable steam pressures in steam mains for controlling with both certainty and ease the distribution and regulation of steam flow to few or many radiators or convectors making up a heating system.

In this method the steam pressure is made to vary in the mains according to the heating requirements, the pressure being controlled either by the regulated intensity of the boiler fires, or by a single reducing valve. It is claimed for this method that it eliminates the necessity of both air and condensation trap valves, and also the use and manipulation of as many and as scattered steam valves as there are radiators and convectors making up any large or small heating system.

The advantages claimed for this method are, first, the uniformity of steam distribution throughout the system, whatever the amount of steam may be required by the several radiators or convectors which constitute the system, and, therefore, the complete control of temperatures through heat yield by that system; and, second, the reduction to a minimum of valve manipulation, the steam quantity used being accurately controllable by a single valve and made exactly equal to the heating requirements, and without waste.

It is in this type of plant that Professor Woodbridge believes his motto of "efficiency, economy and simplicity" will find its most complete exemplification.

### DESIGN OF HEATING SYSTEM FOR WASHINGTON CATHEDRAL.

Under plans and specifications prepared by Professor Woodbridge the method just outlined may, in the near future, be given extensive and crucial demonstration in connection with the Washington Cathedral, in which installation steam is to be supplied to some 85 heaters, mostly of large size, ranged along nearly one-fourth of a mile of steam piping and scattered over an area of some 45,000 sq. ft. All the heaters are to be steam-fed by the manipulation of a single valve, and the steam supplied to every individual heater controlled by a fixed orifice and the steam pressure behind it.

### PROFESSOR WOODBRIDGE AS AN AUTHOR

Professor Woodbridge is the author of a number of monographs dealing with heating and ventilating and allied subjects, reports to Congress on matters pertaining to the Capitol ventilation; also on the proposed central heating and power plant for serving the Executive group of buildings in Washington. He has also been called upon to render reports to various cities and citizens' associations on the sanitary conditions of schools and other public buildings within the scope of their inquiries, and of treatises on subjects connected with his professional work. Probably the best known and most read of his treatises is the one on "Air and Its Relation to Vital Energy," published by the Connecticut State Board of Education.

## Heating Engineers' Annual Meeting

(*Continued from Page 74*)

6.2 cu. ft. of gas, and 0.26 lb. of oil. Electricity at the rate of 1c per K.W.-hr. the above fuels would, to be equivalent, have to cost as follows:

Coal.....$37.73 per ton
Gas.....$1.61 per 1000 cu. ft.
Oil.....$0.28 per gal.

1 K.W.-hr. will produce 3 lb. of steam
10 K.W.-hrs. equals one B.h.p. (standard boiler rating)
1 K.W.-hr. will heat 4 gal. of water 100° F. in 1 hr. (in thoroughly insulated tank).

After determining the necessary heater capacity the next step is to decide on the proper type, size and location of the heater units. For general room heating, he said, there are three distinct types of electric heaters, radiant reflection, radiant convection and simple convection. Mr. Hynes gave details of these various heaters, together with control systems.

The author then took up the use of electricity for producing hot water and steam, for domestic hot water supply.

The remainder of the paper was devoted to a description of larger installations of electric boilers for water or steam heating, or for power purposes. He referred particularly to the electric boiler in the Ford plant at Green Island, N. Y., which is water heated.

### Morning Session, January 23

The first paper at the Wednesday morning session, by Messrs. Norris, Germond and Tuttle described "An Improved Method of Determining the Heat Transfer Through Wall, Floor and Roof Sections" developed at the C. F. Burgess Laboratories, in Madison, Wis.

A paper of much practical interest followed, by N. W. Calvert and J. E. Seiter, on "Economical Utilization of Heat from Central Station Plants." The principal portions of this paper are published on another page of this issue.

This paper elicited a volley of questions which were answered by Mr. Calvert.

A paper was presented on "Heat Emission from Heating Surfaces of Furnace" by A. P. Kratz. This paper described some experiments on a cast-iron circular-radiator type of warm-air furnace, made at the Engineering Experiment Station of the University of Illinois. It was shown that:

1. The heat emission per square foot of heating surface is independent of the type of casing or bonnet for a given set of castings.

2. In the furnace tested, approximately 30% of the total heat emission was emitted by the firepot, 40% by the combustion chamber, 24% by the radiator and 6% by the ash pit.

3. For the cast-iron circular-radiator type of furnace, 1 sq. ft. of surface in the firepot is equivalent to approximately 1.9 sq. ft. in the combustion chamber, 5.9 sq. ft. in the radiator, and 6.7 sq. ft. in the ash pit.

4. At a mean combustion rate of 7 lbs. per square foot of grate surface per hour, approximately 75% of heat emitted by the heating surfaces appears as useful heat in the air circulated based on the heat in the air at the bonnet of the furnace.

In discussing this paper Mr. Richardson advocated the use of sheet-iron radiators for warm-air furnaces in preference to cast-iron radiators.

E. P. Langenberg discussed the research work being done by the warm-air furnace manufacturers and declared that at the present time the furnace heating people know more about their work than do the heating engineers regarding steam and water heating. He also referred to the establishment of the Educational Research Building in which furnace heating will be tested under all sorts of actual conditions.

A note of lively interest was struck when A. H. Ballard, of the Texas Company, presented his paper on "The Status of Domestic Oil Heating." Mr. Ballard departed from the written text and gave the meeting some notable sidelights on present conditions in the oil-heating field.

Mr. Ballard said that up to the present time 25,000,000 tons of coal have been displaced by oil on the Atlantic Coast. This, of course, refers to oil used for power purposes, as well as for domestic heating. Nearly 80% of the crude oils are used for heating and are of little other use.

There are 1500 manufacturers of oil burners, but of these burners 99% are designed for furnace or gas oil. Within two years, he said, the price of such fuels will be prohibitive.

The essential features of a domestic burner are that it shall be fool-proof and free from fire hazard. The only art about the process is the proper atomization of the oil.

Any domestic burner manufacturer must render complete service. The service calls are bound to be numerous.

Mr. Ballard said co-operation was needed to secure higher standards in heating installation work, as, in many cases, the steam distribution is not good enough to permit of the use of thermostats in, say, the living rooms. Very often, with such regulation, although the living room temperatures can be easily regulated, it is likely to leave distant rooms too cold. In such cases the oil heaters are blamed, when it is really the fault of the design causing air-bound radiators.

Mr. Ballard stated that it was the belief of the Oil Burners' Association that within ten years 50% of the domestic steam and water heating plants would be using oil as fuel. As for warm-air furnaces, he said, fuel-oil was not being recommended for such installations, due largely to the danger of leaks and noisy operation.

Storage of fuel-oil, said Mr. Ballard, is an important factor as ample supplies must be provided. Complete atomization is most necessary. An almost equally important factor is the proper introduction of the air. A properly-designed burner will give 80% efficiency.

Mr. Ballard gave the figure of 156 gal. of fuel-oil as equivalent to one ton of coal, although, he said, this varies very much, due largely to the firing methods used with coal.

In specifying the most satisfactory grade of oil to be used, he said that the oil must flow freely at a temperature of zero. This is equivalent to 28° to 30° Baumé.

In the discussion, the suggestion was made that the American Oil Burners' Association establish a research

bureau to determine the proper conditions, etc. for burning fuel-oil.

Other points brought out were that the greatest efficiency with fuel-oil is obtained with the boilers operating at from 125% to 150% of rating. Noise is the greatest problem at present confronting the oil burner industry. Gravity flow of oil, according to Mr. Ballard, is not to be considered.

Cracking of the boiler is caused by localization of the heat. As even a heat distribution as possible should be secured. Care must be taken not to use too small a boiler on this account.

In tests an evaporation equivalent to 14.6 lbs. of steam per pound of coal has been secured.

Mr. Ballard again emphasized the importance of giving service and stated that he would not consider an installation more than 12 miles away from one of his branches.

Before adjourning, the meeting adopted a resolution, offered by J. D. Cassell, of Philadelphia,, expressing the sympathy of the meeting for Frank K. Chew, editor of *Sheet Metal Worker* and long an active member of the society, in his illness, with hopes for his speedy recovery.

### Afternoon Session, January 23

Thursday afternoon's session, as well as a late session in the evening, was devoted to the papers of the Research Laboratory.

Director F. Paul Anderson addressed the meeting. He declared that more progress has been made within a recent period, in all affairs that make life worth living than in all the previous ages. He repeated the point he has made in previous addresses that the engineer is primarily an idealist and that his greatest satisfaction comes through a sense of achievement. The desire to find out the fundamentals which is now characteristic of every industry is a reflection of this idea. We all have enthusiasm, he said, for learning new things about devices in which we are interested.

No field of research, declared Dean Anderson, has greater possibilities than that connected with heating and ventilation. This, he said, is because men have changed from a race out-of-doors to a race in-doors.

Dean Anderson characterized the papers of the Research Laboratory on the program as among the finest contributions of their kind that had been presented within the past ten years. He predicted that the scope of the Research Laboratory should be increased as it is already reaching the point where it can begin to make application of the things that have been learned.

He said the laboratory was now in a position to make tests of existing appliances for the benefit of manufacturers.

The first research paper was that of P. Nicholls on "Measuring Heat Transmission in Building Structures and a Heat Transmission Meter," giving details of the remarkable instrument developed by Mr. Nicholls at the Research Laboratory for actually measuring the heat transfer through building materials. This instrument was characterized by Dean Anderson as one of the great contributions to science.

In addition Mr. Nicholls gave an exhaustive review of the principles involved, with details of the steps taken in developing the heat transmission meter.

The further experiments at the Research Laboratory on 'Critical Velocity of Steam and Condensate Mixtures in Pipes" by F. C. Houghten, Louis Ebin and R. L. Lincoln were presented by Mr. Ebin. These experiments were conducted with special reference to radiator runouts to risers and showed an angle of 55° to be the most effective for one-pipe work.

#### REPORT OF RESEARCH COMMITTEE

The remainder of this session was taken up with the report of the Committee on Research, presented by Thornton Lewis, and the ensuing discussion. Mr. Lewis showed that the 1923 budget of the bureau was $34,050 while the amount actually expended was $33,028.

At the present time there remains $7,737 in the treasury for the operation of the bureau in 1924 while the continuing subscriptions total $5,000, or $12,737 in all, as the amount of the assured income for the coming year. It was therefore necessary for the society to take immediate action regarding the continuation of the Research Laboratory work.

The matter was brought to a head by a motion made by Walter S. Timmis and seconded by H. M. Hart, both of whom are members of the Committee on Research, that the work at the Research Laboratory be abandoned.

This brought forth a lively and extended discussion in which many phases of the research work were discussed. It was brought out, among other things, that the Research Committee is seriously considering a plan to operate the Laboratory on a new basis and to permit manufacturers to have tests made of their products for a definite fee, it being provided that such products are related to heating and ventilating work.

One of the conditions proposed in making tests for manufacturers is that the results of such tests be published in the *Journal* of the Society.

In addition it was proposed that all members be asked to subscribe $10.00 each per year, which would be expected to provide a fund of $15,000.

Another proposal was that the chairman of all the society's technical committees be made associate members of the Research Committee.

It was finally agreed to defer a vote on Mr. Timmis' motion until the following day.

### Evening Session, January 23

A paper presented through the University of Kentucky in co-operation with the Research Laboratory, by Professor L. S. O'Bannon, discussed experiments made at the university on "Simultaneous Flow of Water and Air in Pipes." The paper referred particularly to the condition of flow in the dry return of a vapor heating system and was accompanied by numerous lantern slides showing the extent of the experiments. It was brought out that the Kutter formula applied very nicely to the flow of liquids and gases through small pipes.

Two papers were then presented which supplemented each other, one on "Air Motion, High Temperature and Various Humidities Affecting Physiological Reactions of Human Beings," by Dr. W. J. McConnell, C. P. Yagloglou and F. C. Houghten, and the other on

"Cooling Effect on Human Beings Produced by Various Air Velocities," by F. C. Houghten and C. P. Yagloglou.

Each of these papers contained a mass of data which showed, among other things, how intolerable air conditions due to high temperatures and stagnant air, could be improved by the addition of humidity in connection with air movement.

Dr. E. Vernon Hill suggested that the data should be compiled in a more understandable form, and this view was warmly endorsed by Dean Anderson, who said this would undoubtedly be done after all the experiments were completed.

A paper on "Air Leakage Through the Openings in Buildings" by F. C. Houghten and C. C. Schrader, was presented by Mr. Schrader. The principal results of the tests reported in this paper will be found on another page of this issue.

### HOW THE AMERICAN INSTITUTE OF ARCHITECTS IS PLANNING ITS RESEARCH WORK

Leroy E. Kearn, of the American Institute of Architects, addressed the meeting on the methods being followed by that body to translate, as he expressed it, the technical information gathered by testing laboratories into the language of the architect. He told how the institute had grown in numbers since the World War and how the wider conception of its functions had been realized. Instead of operating as a close corporation, with the lines strictly drawn as to its policies, the institute is now operating to maintain a close contact with other organizations and with manufacturers.

Mr. Kearn told of the organization of the institute's Structural Committee which, in turn, has organized a Scientific Research Department. This committee started with an initial appropriation of $250.00, with the object of compiling existing data regarding structural materials. This has been followed by the organization of a Producers' Research Council, made up of producers of materials and designed to co-operate with the institute. Manufacturers may become members of the Research Council and, in that way, become indirectly identified with the institute.

The session concluded with a paper by Miss Margaret Ingels on "The Production and Measurement of Air Dustiness," in which she described further tests made with this apparatus. The instrument itself was brought to the attention of the society last year. The present tests dealt with "room dust," and two sizes of powdered coal dust and brought out very clearly the usefulness of the dust determinator.

## Morning Session, January 24

Thursday was Code Session day, most of the time being devoted to the proposed Code for Heating and Ventilation developed by a committee under the general direction of L. A. Harding. Mr. Harding made it clear at the outset that the proposed code is still in a tentative form. He mentioned the fact that the Department of Commerce is at work on a general building code in which many of the clauses of the proposed code would probably be incorporated when finally whipped into shape by the society.

He explained that the code is divided into fourteen sections, each section being in charge of a sub-committee.

Dean Anderson presented the first section which was devoted to definitions of terms. This section covered strictly definitions, together with physical units and measurement of heat. It was voted to follow, in a general way, the scheme of denitions as proposed.

Dr. E. V. Hill presented Section 2 which proposed to use the Synthetic Air Chart as the basis for determining ventilation requirements for public buildings. In addition to this, the section gave suggested types of equipment for different Synthetic Air Chart percentages. Formal approval of this method was expressed by the meeting.

### RESEARCH LABORATORY TO CONTINUE ON NEW BASIS

At this point the discussion of the day before was resumed on the proposal to discontinue the society's Research Laboratory. An amendment to leave the decision to a committee composed of the incoming president and the last five past presidents was voted down. Walter L. Fleisher offered the suggestion that the matter of conducting a drive for funds to support the Laboratory be placed in the hands of interests who make a specialty of that kind of undertakings. This suggestion was warmly received.

J. I. Lyle told of the conditions that have to be met in starting such a drive. These include the payment in advance of the percentage charged for conducting a campaign for funds and, inasmuch as such drives are confined to large amounts, the initial expense would be almost prohibitive.

The favor with which the idea was received was reflected in the voluntary subscriptions offered on the floor which rose to $4,800.00 within a few minutes.

After further discussion of the matter, a vote was taken on the original motion to discontinue the work at the Laboratory. The motion was overwhelmingly defeated.

Mr. Lyle then read a resolution which had been prepared by the Research Committee which was, in effect, to open the Research Laboratory to tests of manufacturers' apparatus and appliances under suitable safeguards. After an extensive discussion of the proposed resolution, which was characterized by many as the most important matter the society had ever considered, the resolution as offered by Mr. Lyle, was adopted by an almost unanimous vote.

Under a separate resolution the meeting adopted the proposals.

## Afternoon Session, January 24

Discussion of the proposed Code on Heating and Ventilation was resumed at the afternoon session. Professor A. C. Willard presented Section 3, containing minimum requirements for estimating the heat required for warming buildings. Other sections discussed at this session were those on "Direct Steam or Water Radiation," presented by R. V. Frost; "Indirect Steam or Water Radiation," presented by L. C. Soule; "Heating Boiler Capacity," presented by J. F. McIntire; "Design of Chimneys and Flues," presented by J. R. McColl; "Pipe Sizes for Steam Heating," presented by J. A. Donnelly;

"Pipe Sizes for Water Heating," presented by Walter S. Timmis; "Air Duct for Ventilation," presented by C. A. Booth; and "Air Washers and Humidifiers," presented by W. H. Carrier.

### Morning Session, January 25

The Friday morning session opened with the presentation of a report of the Committee to Consider the Report of the New York State Commission on Ventilation, by C. L. Riley, chairman.

"The greatest disappointment," stated the report, "in this gigantic piece of work is that practically they (the commission) have brought us no nearer the knowledge of what the fundamentals of ventilation should be. Here was a great opportunity to settle disputed theories of long standing. It is true that some side-lights have been given on a few of the factors of ventilation, but these, for the most part, confirm existing beliefs and do not settle, in any way, the various basic requirements in ventilation."

"A ventilation standard," concludes the report, "is the all-important subject to the heating and ventilating engineer. Two principles are at the very foundation of this progress structure:

"1. No specific apparatus or method should be set forth in defining a standard.

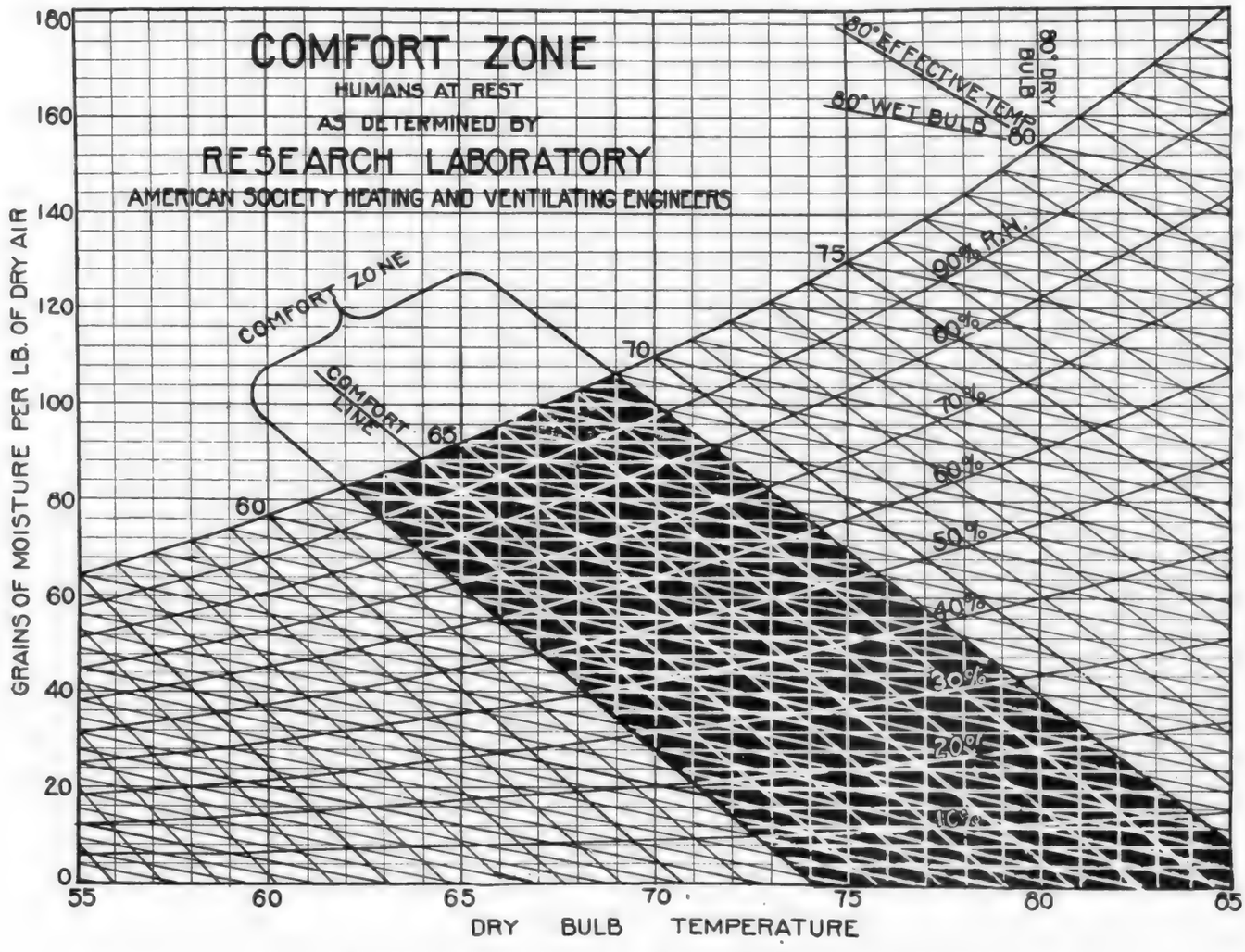
"2. The atmospheric conditions desirable should be the all-important and only consideration.

"Therefore, ventilation perfection is attained when the atmospheric condition in every part of a room occupied by human beings is continually maintained with normal amount of oxygen and free from dust, bacteria, odors and poisons, with suitable air movement and at a temperature and humidity quality shown within the comfort zone, as determined by the Research Laboratory of the American Society of Heating and Ventilating Engineers.

"The apparatus or method that most nearly causes atmospheric air to meet this ventilation perfection or ideal is the most satisfactory."

#### FURTHER DISCUSSION OF PROPOSED CODE ON HEATING AND VENTILATION

Section 3, devoted to "Minimum Requirements for the Design and Installation of Warm-Air Furnace Heating Plants," by Professor J. D. Hoffman, was taken up. It was shown that this section varied in important particulars from the code adopted by the National Warm Air Heating and Ventilating Association. Among these were the rules for calculating leader areas to different floors. It was suggested that the simplified formula of the furnace manufacturers be added as an appendix to Section 7.




**Comfort Zone as Established by A. S. H. & V. E. Research Laboratory**

Section 13, on "Condensation Return Pumps," was presented by Perry West. The concluding section, Section 14, on "Standard Symbols for Heating and Ventilating Drawings," was presented by J. H. Walker. It was brought out that the matter of symbols should be taken up with other interested bodies with a view of securing a set which would serve as a general standard.

Before concluding the session a vote of thanks, expressed with much warmth, was tendered to General Chairman L. A. Harding for his efforts in bringing the proposed code to its present condition.

A resolution was adopted at this session providing for a movement to secure funds for the endowment of the society's Research Laboratory, in accordance with the plans proposed at a previous session.

Walter E. Gillham, president of the Kansas City Chapter and a newly-elected member of the council, extended a warm invitation to the society to hold its next midsummer meeting in Kansas City.

### Afternoon Session, January 25

At the concluding session, Friday afternoon, Chairman C. V. Haynes of the Committee on Increase of Membership predicted a large addition of members during the coming year and gave details of the methods that are being used with success by the New York Chapter. The present membership of 1862 represents an increase of 36% over last year's increase.

An invitation was extended by Charles E. Gorton, representing the American Society of Mechanical Engineers, to have the society arrange to hold its next annual meeting in December, at the time of the annual meeting of the A. S. M. E. and of the Power and Mechanical Exposition.

A resolution in appreciation of the services of the retiring secretary, C. W. Obert, was offered by Mr. Still and adopted by a standing vote.

The new officers were then installed, Messrs. Still and Hart acting as a committee to escort them to the platform.

The meeting was brought to a close with the announcement that William H. Driscoll, of New York, had been elected chairman of the society's Committee on Research.

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### Entertainment Features

As in former years the social event of the meeting was the dinner held on Thursday evening, January 24, in the large ballroom of the Hotel Pennsylvania. No speakers were announced but advantage was taken of the occasion to present the retiring president, H. P. Gant, with a testimonial in the form of a jeweled insignia of the society, the presentation being made by Thornton Lewis.

President Gant responded and this led to a call for the new president, Homer Addams, who responded with a few words, of appreciation.

On the opening night of the meeting there was a reception and dance which brought the delegates together in a merry gathering and on the second day the ladies were entertained at tea in the Palm Room of the hotel.

The arrangements were well carried out by a committee headed by George G. Schmidt, and including G. A. Dornheim, chairman finance committee; H. P. Kahn, chairman hotel committee; M. W. Ehrlich, chairman meetings committee; Arthur Ritter, chairman registration committee; A. Engle, chairman entertainment (dinner) committee; and Miss Helen R. Innis, chairman ladies' committee.

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### Western New York Chapter Hears Address on Underground Steam Main Construction

Speaking on the subject of "Interesting Features of Underground Steam Main Construction," before the Western New York Chapter, at its meeting, January 7, at the Hotel Lafayette, A. L. Lerch, chief construction engineer of the American District Steam Company, presented the possibilities of central heating plants in an interesting manner his talk being illustrated with stereopticon slides.

Previous to his address, L. A. Harding, general chairman of the A. S. H. & V. E. Committee on Minimum Requirements for Heating and Ventilating of Buildings, gave an outline of the scope of the work which was later to be reported in detail at the annual meeting of the society in New York.

Nominations of new chapter officers were announced as follows by the chairman of the nominating committee, Marshall Jackson: For president, Hugo F. Hutzel; for first vice-president, Herman Worsham; for second vice-president, Warren Hills; for treasurer, C. P. Wadley; for secretary, Roswell Farnham.

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### Kansas City Chapter Makes Strong Bid for the Next Summer Meeting of the A. S. H. & V. E.

If the Kansas City Chapter has its way, the next semi-annual meeting of the American Society of Heating and Ventilating Engineers will be held in that city, probably in the latter part of May. At the chapter's January meeting, held at the Kansas City Club, January 7, it was voted to send a formal invitation for the next summer meeting of the society. The assistance of the local Chamber of Commerce has been secured for handling the convention. C. W. Adams reported that he had attended the last meeting of the St. Louis Chapter and that St. Louis is supporting Kansas City in its efforts to secure the summer meeting.

The principal speaker at the January meeting was Dr. E. H. Bullock, health commissioner of Kansas City. Dr. Bullock stressed the importance of legislation on ventilation and emphasized the fact that health authorities and others are looking to the Kansas City Chapter to take the lead in the matter of such legislation for the States of the Southwest.

At the conclusion of Dr. Bullock's address, John H. Kitchen presented E. D. Hornbrook, a local heating and plumbing contractor, and a pioneer in the organization of the plumbing contractors of the country. Mr. Hornbrook told of the work of the National Trade Extension Bureau.

During the business session President Gillham reported on the civic activities of the Club Presidents' Round Table, of which the Kansas City Chapter is a member. A motion prevailed directing the president to appoint a civic affairs committee and that the committee be given fifteen minute's time at each meeting for the general discussion of civic problems.

The committee in charge of the meeting was composed of N. W. Downes, chairman; John H. Kitchen and F. P. Hitchcock. Dr. E. Vernon Hill, who was to have been one of the speakers, was detained by illness. It was expected that Dr. Hill would address the February meeting of the chapter. This was to be a joint meeting with the Kansas City Chapter of the American Institute of Architects, the Architectural League of Kansas City and the Association of Plumbing and Heating Contractors of Kansas City.

Announcement was made of the election to membership in the chapter of Will H. B. Blodgett and George Nelson.

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### St. Louis Chapter Election

Walter A. Klein was elected president of the St. Louis Chapter at the December meeting of the chapter. Other officers elected are: A. M. Lane, first vice-president; J. D. Talvey, second vice-president; E. H. Quentin, treasurer; and Thomas Cale, secretary.

Professor J. H. Kinealy, a former instructor in the department of mechanical engineering at Washington University, who was the speaker of the evening urged members of the chapter to take a more active part in public

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### Air Filters Discussed by Illinois Chapter

J. H. Milliken, of the Reed Engineering Co., and H. E. Birkholz, of the Midwest Air Filter Co., explained the development of air filters at the December meeting of the Illinois Chapter. Dr. E. V. Hill also spoke on the same subject.

Two new members were added and a part of the program was devoted to a discussion of the society's research laboratory.

# Wisconsin's Code for Heating and Ventilating

## Principal Requirements of Most Recent Law to Be Enacted on this Subject, Including Provisions for Recirculation of Air

DETAILS now available of Wisconsin's new code for heating and ventilating show it to be one of the most comprehensive of its kind ever enacted. The code also takes a stand on some matters, such as the recirculation of air in connection with ventilating work, which is a direct outcome of the agitation on this point which has been going on for the past few years in heating and ventilating circles. When finally sent out in printed form, the code will include a set of working rules and diagrams to clarify any doubtful points and to make the requirements easier to understand.

The new code is divided into a preface, six sections, an appendix and a supplement, the latter containing the working rules, with engineering details and suggestions. Section 1 is devoted to code definitions; Section 2, to application of code; Section 3, to general requirements; Section 4, to classified areas and minimum requirements therefor; and Section 5, to classified equipment and particular requirements therefor.

### EXTENT OF CODE

Section 4 gives an idea of the extent of the code, the requirements applying to assembly rooms, motion picture booths, kitchens, churches, school-rooms, vocational and research rooms, wardrobes and locker rooms, toilets, baths and swimming pools, private rooms, general offices, salesrooms, garages, dormitories and wards, and penal institutions.

### SOME TYPICAL DEFINITIONS

Under "Definitions," fresh air is defined as "air" that is stimulating and refreshing and which is free from contamination of any kind in proportions detrimental to the health or comfort of the persons affected thereby." An added note reads: "Recirculated air from interiors of buildings, unless purified by approved apparatus in circuit, does not constitute fresh air as herein defined."

### APPLICATION OF CODE

The code applies to "all buildings used, or to be used, as places of employment or as public buildings, as defined by statutes." This includes not only new buildings and to all repairs exceeding 50% of any such system therein, but to "all necessary alterations or improvements in existing buildings, other than existing places of industrial employment." The code, it is stated, is not intended to be retroactive generally, but where health, safety or welfare conditions warrant, the Industrial Commission retains full statutory powers to order necessary alterations or improvements in existing buildings.

### GENERAL REQUIREMENTS

All plans and data for heating and ventilation installations must be designed and prepared by competent designers. Complete plans for heating and ventilation, together with the specifications applying to the work involved, for all schools and for other buildings of the types mentioned, having a total floor area of more than 1000 sq. ft. must be submitted to the Industrial Commission for approval. It is arranged, however, that in municipalities where plans are examined and building permits issued by a city building inspector, in a manner approved by the Industrial Commission, the heating and ventilation plans should be generally submitted to such local authorities for approval, instead of being sent specifically to the Industrial Commission. Plans must be submitted in duplicate and must be accompanied by details and data sufficient for a specific review of the installation. The data submitted must be those indicated on the standard data sheets issued by the Industrial Commission, the purpose being to avoid the necessity for a detailed study and calculation by the re viewer.

The heat calculations are to be on the basis of temperatures not more than 10° F. higher than the lowest recorded for a given locality by the U. S. Weather Bureau during the preceding ten years.

### PROVISIONS FOR MAINTENANCE AND OPERATION

The following rules are given for maintenance and operation:

*Maintenance.* All heating, ventilation and exhaust installations shall be maintained in good working order.

*Sanitary Conditions.* All heating and all ventilation installations, equipment, accessories, and appurtenances shall be kept clean and sanitary.

*Operation.* All heating, ventilation and exhaust installations shall be operated consistently. *Notes.* (a) It is always desirable to install a recording instrument in connection with a mechanical ventilation system. Such instruments demonstrate the consistency with which the system is operated. A recording air-pressure gauge, an odometer, a recording thermometer, or even a speedometer, will be comparatively inexpensive and will be of great assistance to adequate supervision; (b) In small school buildings, printed memorandum pads provided near the thermometers, have been used with a reasonable measure of success. The teachers are required to make hourly reports of thermometer readings for each day of the week.

**The new heating and ventilation code adopted in Wisconsin, July 6, 1923, and about to be published in printed form, will be administered by the Industrial Commission of Wisconsin, of which R. A. Small is ventilation engineer. As is well known the law was enacted after a series of hearings had been held upon its proposed requirements, in which many heating and ventilating engineers and others participated. When printed the code will include a "Working Rules" supplement, showing engineering details and standards, together with recommendations and interpretations of orders on which there might be question among semi-technical designers, and, possibly, with allied industrial codes affecting particular industries. In the abstract here presented, the more important requirements are given in full. Those for motion picture booths, kitchens, vocational and research rooms, toilets, baths and swimming pools, and private rooms, are omitted, since the ventilation needs of such quarters are generally recognized and provided for.**

### GENERAL AIR CONDITIONS REQUIRED

"Every owner and employer and tenant," states the code, "shall provide and maintain air conditions, temperatures and humidities and motions, which are conductive to the health, safety and welfare of employees and frequenters in respective occupied areas, with due consideration for the nature of the industry therein and the occupancy thereof." Under the provision that there must be no injurious drafts a note is inserted to the effect that 'perceptible currents of air having a temperature of less than 60° F. constitute drafts when in intimate contact with occupants."

Other provisions in this connection are:

*Humidity Required.* All air used for ventilation purposes shall be appropriately humidified or dehumidified to suit the nature of the occupancy or industry affected. (In specific cases where humidity control is impracticable, permission to omit humidity control may be obtained from the Industrial Commission.)

*Maximum Inlet Temperature* 120° *F.* The calculated room inlet temperature of air used for heating and ventilation purposes shall not exceed 120° F., unless under specific written consent of the Industrial Commission. *Note:* In gravity systems it is intended to base the heater capacity, arrangements and control upon inlet temperatures not exceeding 120° F., although in practice it may sometimes be necessary to heat the air to higher temperatures in order to drive it into the rooms.

*Control.* Adequate control, manual or otherwise, of temperature and other conditions and effects of heating and of ventilation, shall be provided and maintained and operated for all heating and all ventilation systems. *Note:* Automatic control is always preferable. Control of dampers and valves by pneumatic or other means permitting interlocking from a central point, is always preferable."

*Recirculation.* Where positive ventilation is required there shall be no recirculation of air unless written consent therefor has been granted by the Industrial Commission; except that where the design, equipment and control, is such as to promote and encourage and reasonably assure consistent operation of the system in practice, recirculation will be

permitted as follows: (a) 100% recirculation while building is entirely unoccupied; (b) 25% recirculation, during occupancy, from occupied areas having no other contamination than human occupancy, without special cleansing devices other than may be required at intakes; (c) 50% recirculation, during occupancy, from occupied areas having no poisonous or severely injurious contamination, where an effective approved dust eliminator is operated in air supply circuit. *Note*: A greater percentage of recirculation during occupancy will be permitted in case satisfactory cleansing and purifying and humidifying apparatus is arranged and maintained in air supply circuits, with positive control insuring operation of such apparatus during all such recirculation.

*Positive Control of Recirculation.* Where recirculation is permitted, the arrangements for securing recirculation shall be positive. *Notes*: (a) Dampers should be interlocked and self-indicating; (b) With mechanical systems, automatic control at the intakes to the apparatus should be provided, insuring favorable temperature and moisture conditions of the air entering the apparatus; (c) It is suggested that when fractional recirculation is in effect, the fresh-air intake area should be reduced proportionately as the area for recirculation is increased. This may be done by dampers interlocked by pneumatic or other mechanical means; (d) It is intended to *require* automatic manipulation of dampers to change from fresh air to recirculation, and vice versa.

### HEATING, VENTILATING AND EXHAUST SYSTEMS—GENERAL

*Heating Systems Required.* Positive heating systems shall be provided, maintained and operated for all occupied areas hereunder, whenever and wherever necessary thus to promote and safeguard the health, saefty or welfare of employees or frequenters.

*Positive Ventilation System Required.* Positive ventilation systems shall be provided, maintained and operated to accomplish required ventilation services for all occupied areas within the scope of this code, wherein the atmospheric conditions would otherwise be detrimental to the health, safety or wellfare of employees or frequenters. *Note*: This includes all places of employment or occupancy wherein smoke, gas, dust, fumes, vapor, foul air or industrial poisons are used, stored, handled or are present in the air in sufficient quantities to obstruct the vision, or to be irritating, or to be injurious to health, safety or welfare of employees or frequenters.

*Gravity Direct-Indirect Systems, Prohibited.* Gravity direct-indirect systems shall not be considered permissible for installation under this code. *Note*: This clause is intended to exclude the use of so-called direct-indirect radiators whereby the room air supply is supposed to be admitted directly from the outside to the base and to be delivered at the top of direct radiators placed in the room to be served, without mechanical assistance.

*Gravity Systems Permitted.* (a) Gravity systems of heating and of ventilation shall be considered acceptable for service for occupied areas of such character, arrangement and moderate size, that uniform distribution of air supply and heat is thereby reasonably insured; (b) Mechanical systems are required for similar service to all other areas.

*Critical Outside Temperature for Gravity Systems.* Approval tests of gravity systems shall be made only when there is not less than 40° F. difference between room temperature and outdoor temperatures. The critical elevation of tests for room-air temperatures, humidities and motions, shall generally be 1 ft. above the normal seat line, where seats are used, or 4 ft. above the floor where seats are not used. *Note*: Usually there should not be more than 4° F. difference in temperature between points about 6 in. above the floor line and similar points 5 ft. 6 in. higher.

*Positive Exhaust Systems Required.* Positive exhaust systems shall be provided, maintained and operated for all occupied areas within the scope of this code, and for all machines, vats, tanks, furnaces, forges, salamanders, and all equipment and processes in such areas which produce or throw off dust sufficiently light to float in the air, or which emit heat, odors, fumes, gas, or smoke, in such quantities as to be irritating or injurious to the health; unless the general ventilation systems keep the air in the breathing zone of every employee or frequenter, pure, fresh and clean. *Note*: The intensity of suction necessary in exhaust systems depends upon local conditions to such an extent that no definite intensity of suction is required herein, except that it shall in all cases be maintained sufficient actually to accomplish the required service in place and in practical operation.

*Exhaust Systems, Clean Discharge.* Where necessary, exhaust systems shall include adequate dust collectors, or air washers, or other machines, contrivances or methods, whereby the discharge from the systems will be prevented from contaminating the breathing zone inside the building or becoming a nuisance or hazard either inside or outside the building.

Following are the principle items of Section 4:

### PLACES OF ASSEMBLY, FIXED SEATS

*Scope.* This classification shall be understood to include theatres, picture theatres, school auditoriums (not classrooms), public lecture halls and similar close-seated areas usually not provided with fixed seats, whether fixed seats are used or not.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas of this class having a seating capacity of fifty or more.

*Minimum Air Supply.* (a) The air supply provided and maintained for occupied areas of this class shall not be less than 3 C.F.M. per square foot of floor area between main walls, not including the stage, but including the gross floor area of balconies and galleries. (b) Similarly, the air supply for foyers and lobbies used in conjunction with occupied areas of this class shall be not less than 2 C.F.M. per square foot of floor area.

*Rear Inlet Air Currents Prohibited.* In areas used for fixed occupancy, the inlets shall be so located, arranged or equipped as to prevent direct inlet air currents from striking the backs of the occupants.

### PLACES OF ASSEMBLY, WITHOUT FIXED SEATS

*Scope.* This classification shall be understood to include lodge rooms, dance halls, dining and banquet rooms, skating rinks, gymnasiums, playrooms and similar areas not normally provided with fixed seats.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for occupied areas of this class (a) where the total window area is less than 10% and the total outdoor openings therethrough is less than 5% of the floor area, respectively; (b) wherever such occupied areas are in, or are used in connection with, school or college buildings.

*Minimum Air Supply.* The air supply provided and maintained for occupied areas of this class shall not be less than 1.5 C.F.M. per square foot of the floor area served.

*Dining Room Ventilation.* Where dining rooms and similar occupied areas are used in conjunction with adjacent or nearby kitchens or other sources of objectionable odors, the spread of such odors throughout the dining rooms should be prevented by appropriate exhaust of a portion of the dining room air supply through the kitchens or other sources of odors.

### PLACES OF ASSEMBLY FOR WORSHIP

*Scope.* This classification shall be understood to mean and include only those auditoriums, social assembly rooms, Sunday School rooms and similar areas which are contained in churches or houses of worship.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas of this class wherein the total window area is less than 10% of the floor area served and the total outdoor openings therethrough is less than 2% of floor area served.

*Minimum Air Supply.* The air supply provided and maintained for occupied areas of this class shall be not less than 1 C.F.M. per square foot of floor area.

*Alternate Service.* All ventilation systems installed in occupied areas of this class shall be arranged for selective delivery of entire service to either the auditorium floor or the basement floor areas, unless the air supply thereby is more than 2 C.F.M. per square foot of floor area.

*Alternate Capacity.* Where ventilation systems serve auditorium and basement floor areas in this class, the capacity of such system may be used upon alternate service to auditorium floor areas alone, when the air supply furnished thereto exceeds 2 C.F.M. per square foot of floor area.

### SCHOOLROOMS

*Scope.* This classification shall be understood to include class, recitation, study and library rooms in all school and college buildings and similar areas used for educational purposes.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas of this class, except those which are used for open-air or outdoor treatment.

*Minimum Air Supply.* (a) The air supply provided and maintained for occupied areas of this class shall not be less than 2 C.F.M. per square foot of floor area; (b) similarly, the air supply for corridors and halls used in conjunction with occupied areas of this class shall be not less than 0.5 C.F.M. per square foot of floor area.

*Alternate Service and Capacity.* The capacity of heating systems and of ventilation systems installed in school buildings having not more than two classrooms may be based upon service to classroom floor only, pro-

vided that where basement apparatus is used, appropriate arrangement shall be made for alternate service to basement areas if used for occupancy.

WARDROBES AND LOCKER ROOMS

*Scope.* This classification shall be understood to include all wardrobes and locker rooms and similar areas in all buildings within the scope of this code.

*Positive Ventilation Required.* (a) Positive ventilation shall be provided and maintained for all areas of this class; (b) whenever practicable, such ventilation shall be accompanied by exhaust methods and, in any case, the effectiveness of the outlet shall not be less than that of the inlets.

*Minimum Air Movement.* The air movement provided and maintained for areas of this class, wherein positive exhaust ventilation is required shall be not less than 2 C.F.M. per square foot of floor area.

*Combination Rooms.* (a) Positive direct air supply of not less than 10 C.F.M. per locker (5 C.F.M. per locker) or individual hanger space, in addition to the air supply required for use as halls or corridors, shall be provided and maintained for all halls and corridors containing lockers for clothing, or which are used as wardrobes or cloakrooms; (b) positive inlets and outlets shall be provided and maintained for such areas and the activity of the outlets shall not be less than that of the inlets.

*Wardrobes and Cloakrooms in School Buildings.* (a) Where necessary, in order to insure practical results in such areas, the required ventilation shall be accomplished by use of positive inlets admitting air from adjacent classrooms or corridors or similar areas, in conjunction with positive outlets and ducts discharging direct to outside atmosphere; (b) the movement of air in such areas shall be such as to promote thorough aeration of clothing therein.

GENERAL OFFICES

*Scope.* This classification shall be understood to include all offices and similar occupied areas other than those included under "Private Rooms," wherein the air conditions and nature of occupancy do not involve reasonable inclusion in any other classification in this section of the code.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas of this class: (a) wherein the total window area is less than 6% of the floor area or the total area of outdoor openings is less than 3% of floor area; (b) wherein the available floor area is less than 50 sq. ft. for each normal occupant; (c) wherein heat or odors would otherwise be present in sufficient quantities to be injurious to the health, safety or welfare of the employees or frequenters affected.

*Minimum Air Supply.* Where positive ventilation is required, the minimum air supply for occupied areas of this class shall be not less than 0.5 C.F.M. per square foot of floor area.

SALES-ROOMS

*Scope.* This classification shall be understood to include all salesrooms and other occupied areas of similar character.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas of this class unless the aggregate of outdoor openings is more than 3% of the floor area served, and provided that such outdoor openings are arranged so as to cause air circulation throughout the respective rooms.

*Minimum Air Supply.* Where positive ventilation is required, the air supply provided and maintained for occupied areas of this class shall be not less than 1 C.F.M. per square foot of floor area on the first floor, with a cumulative decrease of 10% for each floor above the first floor, and a cumulative increase of 10% for each floor below the first floor.

GARAGES

*Scope.* This classification shall be understood to include all public garages and all employment areas in any building housing three or more motor-driven vehicles. *Note*: This order is particularly applicable in case of vehicle provided with internal-combustion motive power.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas in this class. *Note*: Suitably-inclosed areas used only for storage of new motor vehicles which do not contain fuel or storage batteries need not be ventilated under this clause.

*Minimum Air Supply.* The air supply provided and maintained for all occupied areas of this class shall be not less than: (a) where ventilation is effected by displacement of the contaminating gases, 1.5 C.F.M. per square foot of live storage area and 3 C.F.M. per square foot of repair area served; (b) where ventilation is effected by dilution of contaminating gases, 15 C.F.M. per square foot of live storage area, and 30 C.F.M. per square foot of repair area served.

*General Requirements.* The products of combustion and vapors or gases from fuel or batteries shall be removed promptly and effectively from the breathing zones of employees and frequenters, and there shall be at all times not less than 2500 cu. ft. of fresh air for each cubic foot of carbon monoxide in such breathing zones. *Notes*: (a) carbon monoxide gas is invisible, odorless, tasteless and a deadly poison. It is slightly lighter than air. Gasoline fumes are nearly four times as heavy as air.

PLACES OF EMPLOYMENT, GENERAL

*Scope.* This classification shall be understood to include all places of employment not classified elsewhere in this section of code.

*Positive Ventilation Required.* Positive ventilation shall be provided and maintained for all occupied areas of this class (a) where the available floor space is less than 75 sq. ft. per normal occupant; (b) where heat, smoke, gas, dust, fumes, vapor, foul air or other contamination would otherwise be present in the air in sufficient quantities to obstruct the vision or to be irritating or to be injurious to the health, safety or welfare of employees or frequenters; (c) where industrial poisons are to be used, stored or handled, or would otherwise be present in the breathing zone.

*Minimum Air Supply.* The air supply provided and maintained for occupied areas of this class shall be not less than an amount sufficient to make up for contamination of air due to the nature of the work being carried on, plus (a) 1 C.F.M. per square foot of floor area; (b) in no case less than 30 C.F.M. per normal occupant.

*Exhaust Systems Required.* Positive exhaust systems shall be provided and operated for and at all sources of air contamination in occupied areas of this class, unless the air which any employee or frequenter must breathe is otherwise kept pure, fresh and clean.

DORMITORIES AND WARDS

*Scope.* This classification shall be understood to include rooms equipped with more than two beds.

*Window Ventilation.* Window ventilation may be relied upon for occupied areas of this class wherein the available window area is more than 10% of the floor area served and the outdoor openings therethrough is more than 5% of the floor area served.

PENAL INSTITUTIONS

*Scope.* This classification shall be understood to mean and include areas of compulsory occupancy in penal institutions, such as cells and corridors and similar areas.

*Minimum Air Supply, Mechanical Ventilation.* Where mechanical ventilation is required for occupied areas of this class, the air supply shall be not less than 0.5 C.F.M. per square foot of cell area served. *Note*: workshops in penal institutions shall be served in the same manner as places of employment housing similar industrial processes, as classified elsewhere herein.

*Gravity Ventilation Permitted.* Gravity ventilation using direct gravity inlets and gravity outlet ducts, shall be considered permissible for occupied areas of this class wherein each cell or individual part of cell comprises more than 100 sq. ft. of floor area, or a total direct outdoor opening area equal to not less than 10% of the floor area *Note*: Properly-arranged operative windows opening directly from cell to out-of-doors may be relied upon as direct gravity inlets, under the foregoing item.

*Mechanical Ventilation Required.* Mechanical ventilation shall be provided and maintained for all occupied areas of this class having less than 100 sq. ft. of floor area, or total direct outdoor opening area equal to less than 10% of the floor area, for each cell or individual part of cell.

CLASSIFIED EQUIPMENT AND PARTICULAR REQUIREMENTS THEREFOR

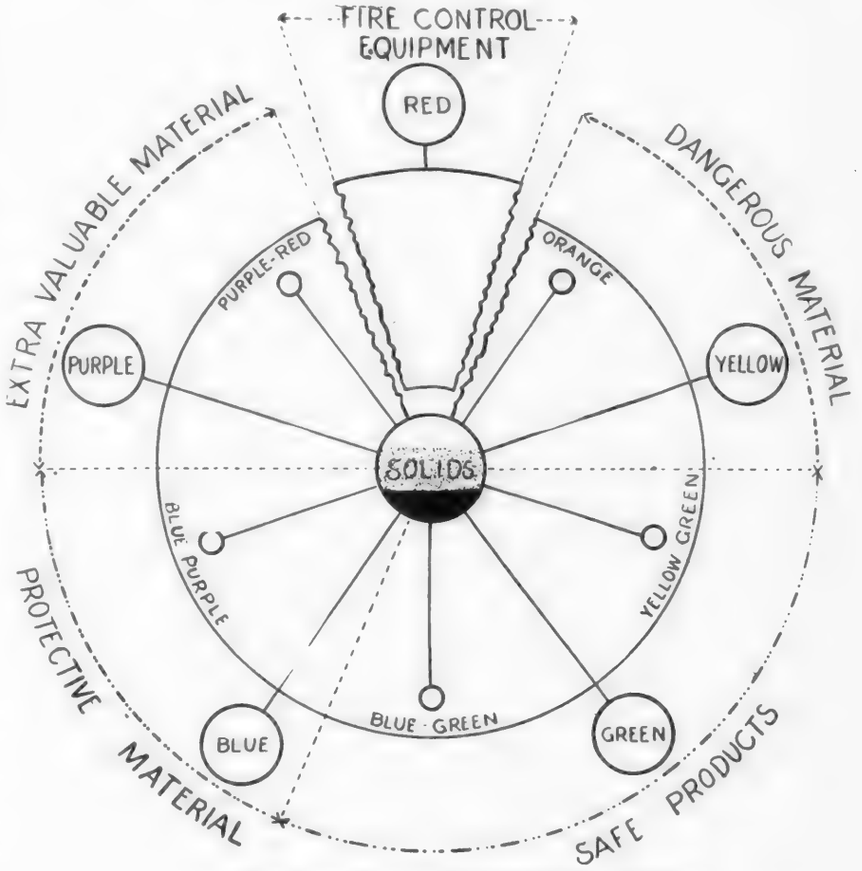
The final section of the code covers such matters as fresh-air intakes, air purification apparatus, heaters, boilers, furnaces, jacketed stoves, stack heaters, chimneys, fans, ducts, dampers, positive inlets and outlets, direct radiation, indirect radiation, humidifiers and piping. Following are the principal requirements in this section:

*Air Purification Apparatus.* The construction, design and control of all air purification apparatus shall be such as to insure consistent maintainance and operation thereof. Dirty water shall not be recirculated through sprays affecting air used for ventilation purposes, and not less than 20% of air washer water used shall be renewed during each day of operation, exclusive of makeup water; and the water reservoir shall be emptied and thoroughly cleaned and refilled with fresh water after each week's operation.

Under "Ducts" it is provided, among other things, that inlets in floors shall not be considered permissible in areas classified under

"Schoolrooms," nor in other areas where subject to contamination of inlet air incident to foot traffic or other floor-line conditions. Outlets in floors shall not be considered permissible in such areas, nor in other areas where air passing therethrough is at any time recirculated before delivery to outside atmosphere; nor in conjunction with gravity outlet ducts, unless adequately protected against contamination incident to foot traffic and other floor-line conditions.

*Humidifiers.* Humidifiers used in conjunction with ventilation systems shall be so located and arranged that they will effectually treat all the ventilation air handled by the respective ventilation systems, unless otherwise permitted by the Industrial Commission. Humidifiers shall be calculated, maintained and operated on the basis of not less than 40% relative humidity, measured at 70° F. for total air supply, unless otherwise directed by the Industrial Commission. The reservoir capacity in connection with water-pan humidifiers shall be not less than enough for one normal day of operation. The water level in water-pan humidifiers having supplementary reservoirs or supplied from pressure systems, shall be controlled and maintained by means of float valves, or similar automatic devices, in the water supply lines outside of the heat chambers. The evaporative surface of water-pan humidifiers shall be not less than equivalent to 200 sq. in. of water-pan evaporative surface per 1000 C.F.M. of air supply to be treated. Water-pan humidifiers shall be located in the heated air chambers of heater units, or in similar location.




**New Color Scheme for Identifying Piping.**

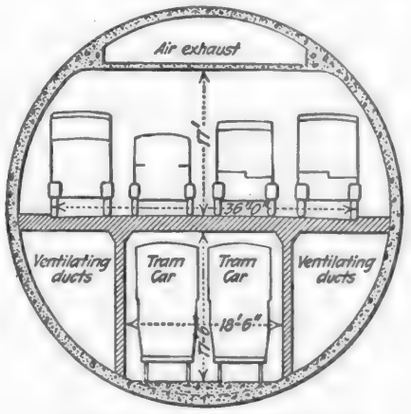
## Plan of English Mersey River Tunnel

Plans for the proposed highway tunnel under the Mersey River to connect Liverpool and Birkenhead, England, proivde for a single bore 44 ft. inside diameter. Sir Maurice Fitzmaurice, M. E. I. C. Basil Mott and John Brodie have been named as consulting engineers for the project.

The tube will be located a little downstream from the Mersey Railway tunnel and is to have a river length of about 4,000 ft. There will be long approaches with a 5% grade for light traffic and a 3% grade lateral approach for the heavy dock-district traffic.

At the center line of the tunnel section there will be a 36-ft. deck enough for four lines of vehicles, and two narrow sidewalks. Two supporting walls for this deck would form a central section for street cars and side sections for ventilating ducts, as shown in the accompanying illustration.

A flat roof or ceiling forming an air exhaust duct along the top of the tunnel will be located about 17 ft. above the upper deck. The plan calls for a cast-iron shell with interior concrete lining and with grout pumped to fill all exterior voids. The cost is estimated at $32,000,000.




**Proposed Highway Tunnel Under Mersey River.**

## New Project to Identify Piping Systems by Colors.

Acting under the rules of the American Engineering Standards Committee and sponsored by the American Society of Mechanical Engineers and the National Safety Council, a sub-committee of the A.E.S.C. has just prepared a tentative report on the identification of piping systems by colors. Other sub-committees are at work on classification and on identification markings other than color.

In laying out its work, the sub-committee classified the various piping systems as those carrying safe products, those conveying extra valuable material, those carrying dangerous materials, those carrying protective materials and those connected with fire-control equipment. The sub-committee felt that each of these five classifications should be given a major color, and the various sub-divisions that a plant may need could be obtained by the use of numbers, names or the like, painted in white or black upon a background of the color selected.

The sub-committee took the solar spectrum as a basis, dividing it into five sectors. Each sector was intended to represent one of the five major classes and, of course, was capable of sub-division, where necessary, into a larger number of hues having approximately similar dominant wave lengths, but distinguishable from each other very readily under favorable illumination.

As was to be expected, red was assigned to all sorts of fire-control apparatus. Yellow was assigned to pipes carrying substances highly dangerous to health, life or property, if allowed to escape. This selection was based partly on the use of the yellow quarantine flag and partly because of its high visibility. The assignment of the three other sectors to the remaining classes follows in regular order and may be readily understood by reference to the accompanying diagram.

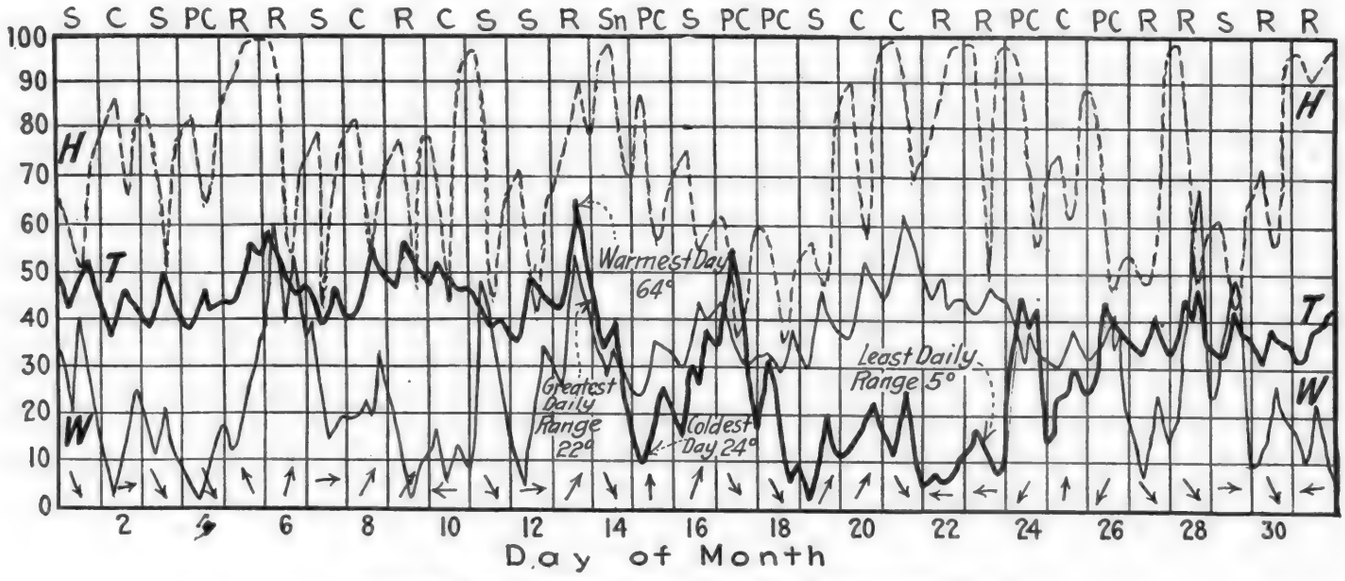
It will be noted that nothing in the color scheme provides for the use of black paint. In commenting on this the sub-committee states that while black paint is the ideal paint for pressure steam pipes, in most modern plants such pipes are insulated by various kinds of covering, mostly white or nearly so, and in general not in need of any kind of paint. Such pipes, states the sub-committee, may still be painted black as protection against corrosion, but the covering is best marked for identification by the letters, symbols, or signs suggested.

The committee which drew up the report is made up of F. P. Ingalls, chairman; E. J. Cole, I. J. Fairchild, Crosby Field, H. A. Gardner, and M. R. Paul.

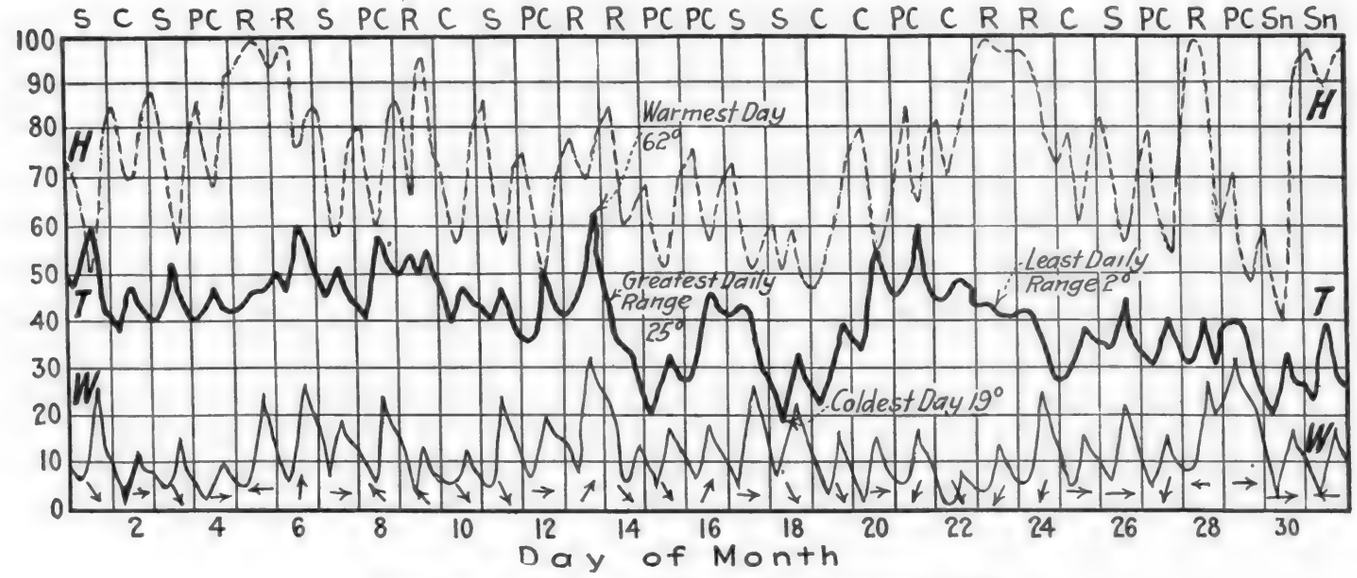
A hearing on the report was scheduled for January 10, and additional suggestions should be addressed to I. G. Hoagland, secretary of the Sectional Code Committee on Code for Identification of Piping Systems, in care of the National Automatic Sprinkler Association, 80 Maiden Lane New York.

# The Weather for December, 1923

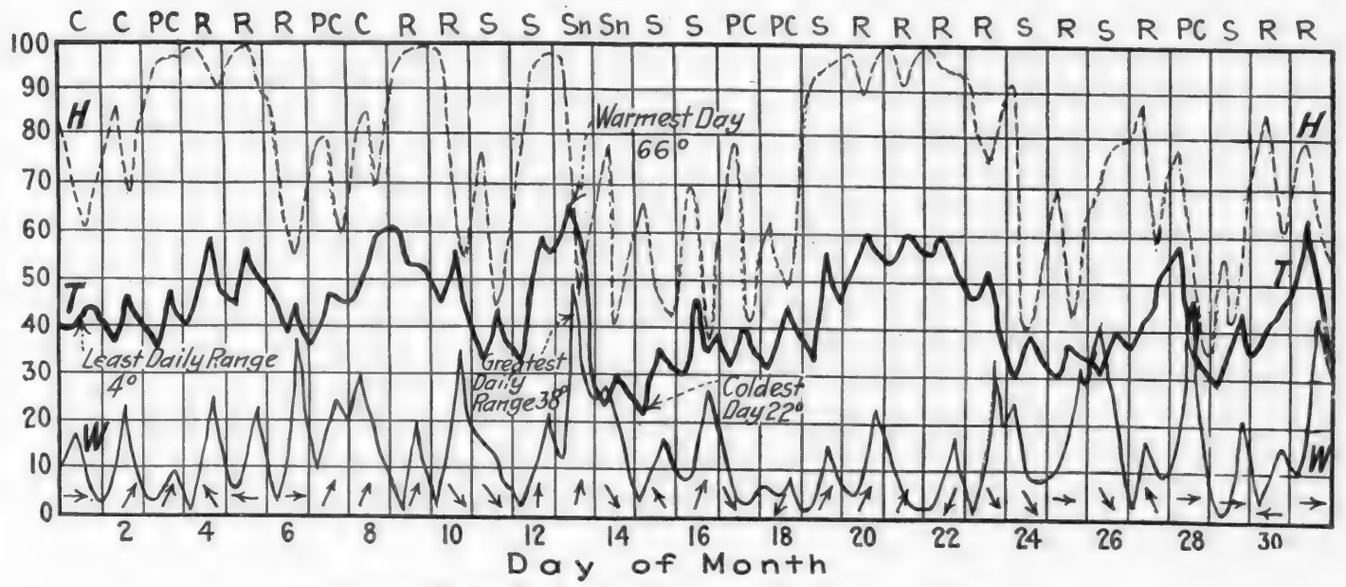
| | New York | Boston | Pittsburgh | Chicago | St. Louis |
|---|---|---|---|---|---|
| Highest temperature, deg. F. | 64 | 62 | 66 | 53 | 70 |
| Date of highest temperature | 13 | 13 | 13 | 18 | 27 |
| Lowest temperature, deg. F. | 24 | 19 | 22 | 8 | 11 |
| Date of lowest temperature | 15 | 18 | 15 | 31 | 31 |
| Greatest daily range, deg. F. | 22 | 25 | 38 | 30 | 27 |
| Date of greatest daily range | 13 | 14 | 13 | 31 | 31 |
| Least daily range, deg. F. | 5 | 2 | 4 | 3 | 3 |
| Date of least daily range | 23 | 23 | 1 | 9 | 23 |
| Mean temp. for month, deg. F. | 42 | 40.4 | 43 | 39.7 | 44.4 |
| Normal mean temp. for month, deg. F. | 35 | 31.8 | 34.2 | 30 | 34.8 |
| Total precipitation, in. | 3.78 | 4.99 | 6.22 | 1.96 | 3.3 |
| Total snowfall, in. | 1.2 | 3 | 1 | 1.6 | 0.7 |
| Normal precipitation, in. | 3.45 | 3.41 | 2.73 | 2.07 | 2.23 |
| Total wind movement, miles | 13649 | 7639 | 8287 | 9455 | 9822 |
| Average hourly wind velocity, miles | 18.9 | 10.3 | 11.1 | 12.7 | ..... |
| Prevailing direction of wind | N. W. | W. | S. W. | W. | S. |
| Number of clear days | 8 | 7 | 3 | 9 | 9 |
| Number of partly cloudy days | 8 | 11 | 7 | 7 | 4 |
| Number of cloudy days | 15 | 13 | 21 | 15 | 18 |
| Number of days on which rain fell | 13 | 13 | 16 | 13 | 10 |
| Number of days on which snow fell | 4 | 3 | 2 | 2 | 1 |




**Record of the Weather in New York for December, 1923**




**Record of the Weather in Boston for December, 1923**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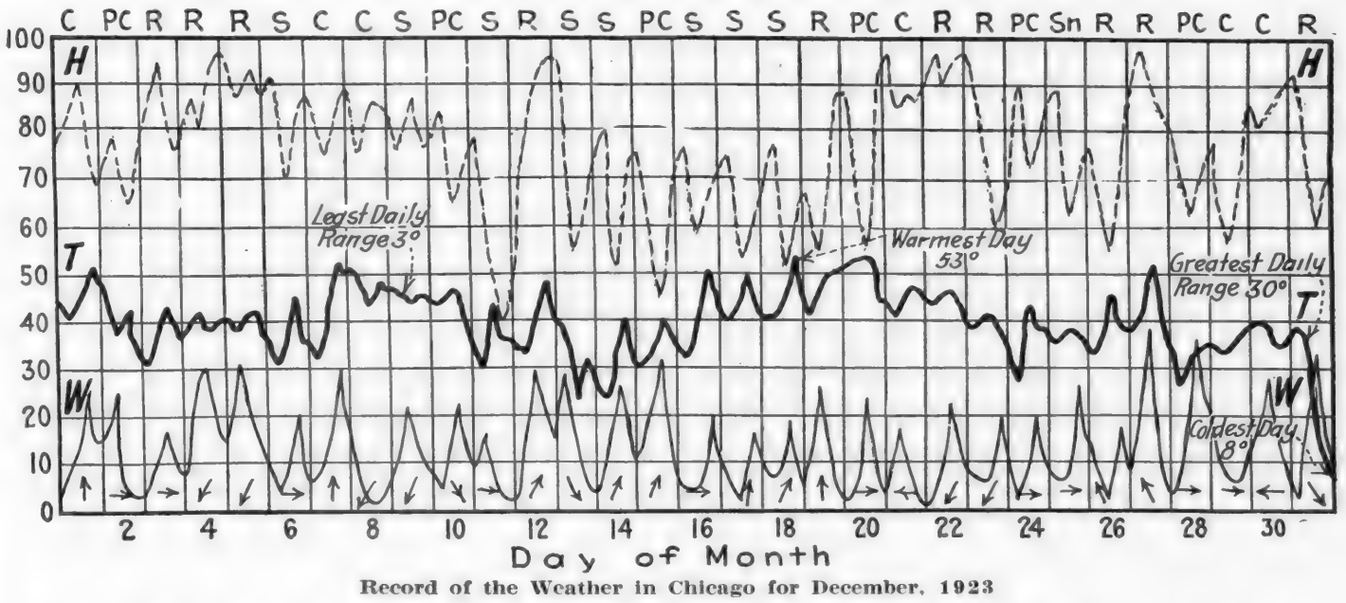
Warmest Day 66°
Least Daily Range 4°
Greatest Daily Range 38°
Coldest Day 22°
Day of Month

**Record of the Weather in Pittsburgh for December, 1923**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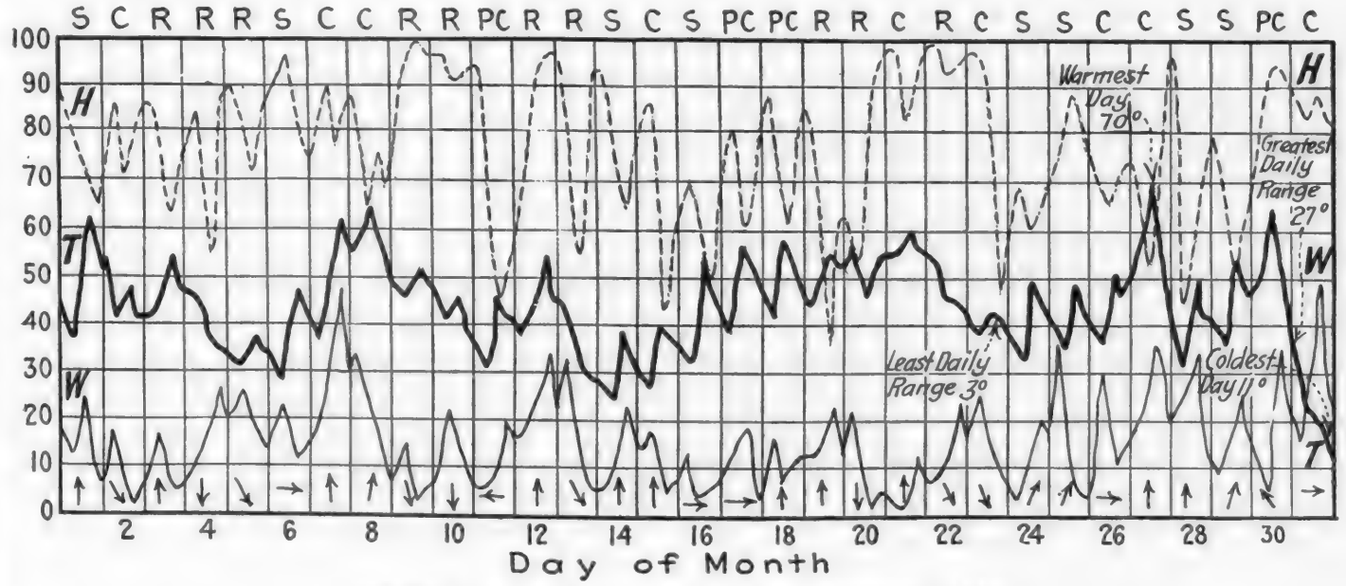
Least Daily Range 3°
Warmest Day 53°
Greatest Daily Range 30°
Coldest Day 8°
Day of Month

**Record of the Weather in Chicago for December, 1923**


S C R R R S C C R R PC R R S C S PC PC R R C R C S S C C S S PC C
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Warmest Day 70°
Greatest Daily Range 27°
Least Daily Range 3°
Coldest Day 11°
Day of Month

**Record of the Weather in St. Louis for December, 1923**

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 A. M., 12 M., and 8 P. M.
S—Clear, PC—partly cloudy, C.—Cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of wind.

# Correspondence

## Preventing Water Hammer in Radiators

EDITOR HEATING AND VENTILATING MAGAZINE:

While in charge of a heating plant which consisted of a one-pipe steam system, I was compelled to increase the radiation in one part of the building in order to have the proper temperature which that part of the building needed.

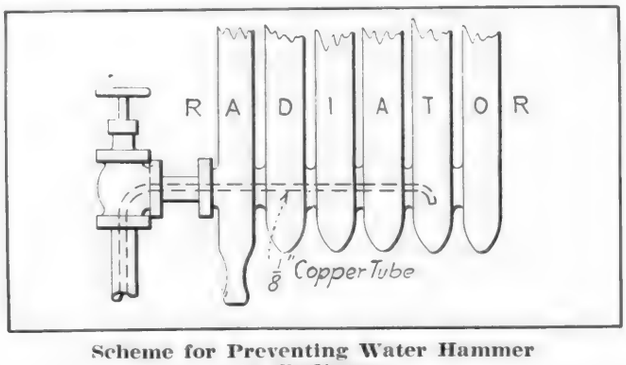
After looking the system over I could not find any more convenient means for doing so than to add sections to each of the existing radiators. This I did in the usual way by parting some of the sections and setting in the desired number of additional sections.

Thinking my job complete I then turned on the steam to each of the radiators. I found that I was still in trouble, as the condensation in the radiators could not get out on account of a much larger amount of steam going in to heat the additional sections, so that there was no room left for the water to pass it.

The result was that the water surged back and forth in the radiators, causing a severe water hammer, and causing a considerable amount of water to squirt through the air vent valves. This warlike action within the radiator lasted for about an hour, and then the system gradually settled down to business, and heated as all good behaving radiators should.

Now these radiators worked fine when the water got out, and to remove the water was a problem. Before spending money on larger steam pipes and valves we decided to try the stunt which is shown in the sketch.

The radiators were disconnected at the union, and a ⅛-in. copper tube was set in the valve, bent so that it would extend down the steam riser about 8 in. as shown. The other end was straightened out with a little bend at the end, as shown, then the radiator was brought to place with the copper tube inside of it.




**Scheme for Preventing Water Hammer in Radiators**

The overall length of the copper tube was two-thirds the length of the radiator, and could be of a larger size than ⅛-in.

It operated as follows:

The water when surging, is forced against the rear end of the radiator with a great momentum that will give a much higher pressure than the force that drives it, and as liquid presses equally in all directions, it is forced in the copper tube and out against the steam pressure.

Once in operation, the 8 in. extending down the steam riser will keep the flow of water going until the water is siphoned out. With this device I have not even heard a water knock, or seen the air valve throw water, and always have the sections warm up in regular order, and what is more, it fills the bill.

It serves the purpose as well as though it cost $25.00 to have each radiator supplied with a larger pipe and valve. This tube, of course prevents the valve from closing, but to close off the steam, we turn the air valve upside down, which causes the radiator to be air bound. This method of closing off steam will save many radiators from filling with water, then freezing and bursting, as so often happens.

C. Rye.

Winnipeg, Man.

## How the Urbana Educational Research Building May Be Used

Some idea of the use to which the Educational Research Building of the National Warm-Air Heating and Ventilating Association will be put is given by Professor A. C. Willard, professor of heating and ventilation and head of the Department of Mechanical Engineering at the University of Illinois, who is in charge of the warm-air furnace testing at Urbana for the research bureau of that association. Writing in *Sheet Metal Worker*, he emphasises the fact that operating tests of a furnace heating system conducted in such a house will make it possible to compare and correlate the results of tests of furnaces which are now being made in the laboratory, with the results obtained on the same furnace under actual house conditions.

Also, there are certain performance factors of vital interest to the manufacturer and installer, he states, which cannot be determined in the laboratory. One of these is the effect of wind on the proper circulation of the air to those rooms which are on the windward side of the house. The study of this problem, he states, will develop the true value of tight windows, double sash and metal weather strips in furnace heating.

Another of these factors is the relative value of inside and outside air supply to the furnace. A third is the importance of and the proper degree of humidity which should be maintained in a furnace-heated house. On this point the investigations, it is hoped, will answer the questions: Does a reasonable relative humidity make it possible to carry a lower air temperature in the house with comfort? Does this condition actually result in a saving of fuel or not? Can you properly and successfully humidify houses with windows of single glass which are often not tight, so that the water vapor is lost as fast as supplied by the humidifier, or must you use double sash or weather strips to stop some of the leaks and prevent condensation on the cold glass?

A fourth "field" test will be that of the effect of outside cold walls on air circulation and temperature variation from floor to ceiling in actual rooms. A fifth will deal with the effect of location of warm-air furnace in the basement on the successful heating of the house.

Other factors, which will be more readily determined under the new conditions, are the effect of return-air ducts below the floor entering a pit under the furnace, as compared with return-air ducts run above the floor and entering the casing above the base ring; proper location and arrangement of the registers for recirculating air in a system using all inside air; effect on heating air inlet registers; effect of installation details of any room of the location of the warm- on the operation of wall stacks to second and third floors; effect of installation details on leaders, or the warm-air pipes in the basement; relative value of an inside chimney which runs up through the center of the house, compared with an outside chimney at the end of the house; effect of maintaining constant temperature day and night, as opposed to normal temperature by day and lower temperature at night.

Finally Professor Willard lists such an experiment as that of a remote room with three sides exposed, and the room in the attic, together with the most effective arrangement for the sun porch, involving possibly a separate return-air duct.

In addition to the foregoing the house, of course, will afford an opportunity to check up many of the requirements of the new furnace installation code.

## New York State Heating and Piping Contractors

D. Cady Fulmer, Syracuse, N. Y., was elected president of the Heating and Piping Contractors' New York State Association, at the twenty-eighth annual convention, held January 8 at the Powers Hotel, Rochester, N. Y.

Other officers selected are: Paul W. Schneider, Utica, N. Y., vice-president; William J. Olvany, New York, secretary and treasurer. These three officers and H. W. Jones, Rochester; William G. Fraser, Buffalo, C. Ashmusen, Albany; and F. J. Weider, Rochester, constitute the 1924 board of directors.

The convention went on record as favoring a meeting of State associations on the day preceding each annual convention of the national association. It was suggested also that the association take an active part in the proper training and education of apprentices

## Ford Factory Electrically Heated

The factory of the Ford Motor Company, at Green Island, N. Y. is heated by hot water which is heated by electricity. The building is 1,140 ft. long, 120 ft. wide, and consists of three bays, the two side bays being about 20 ft. in height and the central bay about 35 ft. in height. The outer exposure of this building consists of about 60% of glass. 65,000 sq. ft. of radiation is installed. Water is circulated by motor-driven centrifugal pumps at the rate of 1,500 gal. per minute, and at a pressure of about 40 lbs.

The water is circulated through one or two electric heaters, depending upon weather conditions, and is raised in temperature from 135° F. to about 153° F.

The heaters are of the electrode or water resistance type, having a capacity of 3,200 k. w. each, and are operated at 4,600 volts, 3 phase, 60 cycles. The electrical input is controlled by the level of the water in the boiler as in the case of a steam generator and independent of the pump pressure. The change of water level is accomplished by an air column in the heaters, the length of which can be varied at will by admitting or releasing air. Air for this purpose is supplied by the compressed air system of the plant.

The control of power input is, therefore, simple and could be accomplished by thermostatic attachment if desired, but since the boilers or heaters operate steadily and it is only necessary to change the power input according to outdoor temperature, thermostatic control, it is found, is hardly worth while.

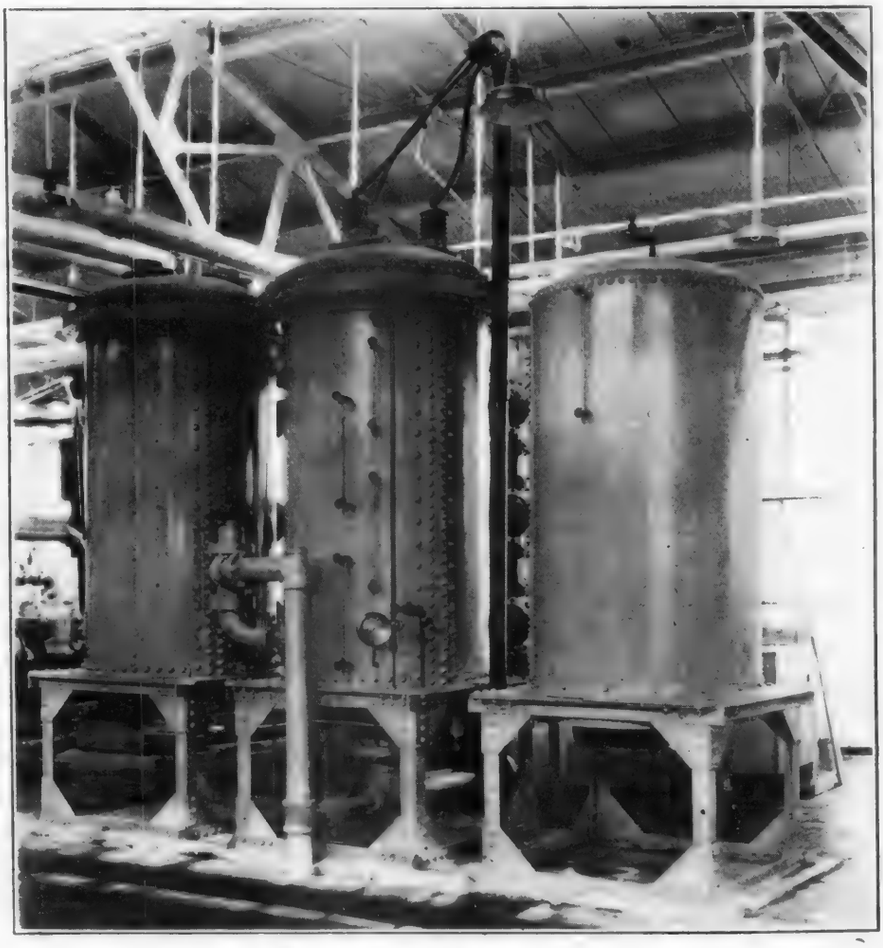
The heaters are specially equipped with baffle plates to prevent the direct passage of cold water through them. Inasmuch as the heaters are installed in the building to be heated they are not covered and of course, their efficiency is 100%.

Each heater occupies a floor space 4 ft. square and a surge tank occupying an equal amount of floor space is required in order to avoid waste of water when the load on the heaters is reduced. Thus a small amount of water needs to be added occasionally to make up for leakage from the system.

Among the considerations that determined the selection of this method of electric heating were cleanliness, minimum of space required and efficiency. No separate heating plant was required and, consequently, no provision was necessary for fuel storage, ash handling or labor. The heaters require occasional attention by a janitor or other attendant who also looks after the circulating pumps and other duties.

Commenting upon the opportunities for the application of electric heating to buildings on a large scale, Vice-President F. H. Falter of the Electric Furnace Construction Co., Philadelphia, whose heaters are used in the Ford installation, calls attention to the fact that while such opportunities on a large scale are limited, heaters of this type will be found adaptable for feed-water heating, in which case they could be thermostatically controlled to maintain the feed water at any desired temperature.

Mr. Falter estimates that if only the surplus power of an electrical system were employed to heat feed water or to produce steam for a feed-water heater, an electric steam generator would pay in the value of the coal which it would displace. The load factor on a system could thus be maintained at practically 100% and the power factor would be favorably affected since such a boiler or heater, being a non-inductive load, operates at unity power factor. The cost of the installation is comparatively low and the cost of operation can be reduced to a small item where the electric heaters or boilers can be put in charge of a regular boiler-room crew.



**Two 3000-K. W. Electric Water Heaters. Installed at Plant of Ford Motor Co., Green Island, N. Y.**

## Burning 95% Air in a Gas Burner.

The statement sometimes made by manufacturers of gas or oil burners that their apparatus burns 95% air is not so much exaggerated as it is senseless. Commenting upon this point, N. T. Sellman, assistant secretary-manager of the American Gas Association, states that in a kerosene heater, such a claim is approximately correct, insofar as approximately 95% of air by weight is needed to burn kerosene completely.

In the case of manufactured gas this ratio is more nearly 5 to 1. That is, it requires five volumes of air to one volume of gas. By weight this would be about 7 lbs. of air to 1 lb. of gas.

The efficiency of the burner, whether it is gas or kerosene, depends upon how this required quantity of air is mixed with the fuel. The chances are that instead of burning the theoretical amount of air, 95% as often claimed, there is being supplied in all probability considerably more air than that which is required, because it is practically impossible to come within the limit of the theoretical amount unless there is a very thorough mixing and proportioning device to accomplish this. In ordinary burners, where the velocity of the fuel injects its own air, it is necessary to supply a considerable excess in order to be sure that all the air will be present to accomplish complete combustion.

## Standardization of Technical Nomenclature

As is well known, the American Engineering Standards Committee has for some time been making efforts to compile international standards covering symbols for heat and steam. In the mean time a report of progress has been issued by "Committee No. 20" on the standardization of technical nomenclature. This report briefly reviews the work of recent years and presents certain symbols for heat and steam for the consideration of those interested. This list, it is pointed out, is not offered for adoption, for the reason stated, that international standardization will probably be accomplished by the A. E. S. C.

If international standardization does not occur soon, states the report, the symbols given may be used as a starting point for a standard list of symbols in heat and steam for the United States. The report is signed by John T. Faig, of the Ohio Mechanics Institute, Cincinnati, O. and it is asked that comments on the report be sent to him at that address.

# Legal Decisions

## Steam Heating Utility Allowed 8 Per Cent. Return—Flat Rates Allowed in Special Circumstances, Though Meter Rates Preferred

Following an investigation into the rates, charges, and value for rate making purposes of the property of the Red River Power Company, a gas, electric and heating utility, at Grand Forks, North Dakota, the North Dakota Board of Railroad Commissioners has made a reduction in rates for general lighting, and continued in effect the existing gas and steam heating rates.

The commission found that the utility is rendering efficient service and is efficiently operated, and that a rate of 8% upon the property used and useful in furnishing service was reasonable, under the rule that where a utility is rendering efficient service and is on the alert to practice economy, the rate of return should be higher than in the case of an inefficiently operated plant.

The commission provided for this rate of return in the case of the steam heating department in the following manner:

The record showed there are 220 steam heating consumers. An analysis had been made to determine the actual sales to each consumer, and a full and complete analysis made of the operating expenses for the year 1922. Upon all the facts before it, the commission prepared a statement of estimated expenses for the next twelve months.

The valuation determined by the commission for the steam-heating department as of February 1, 1922, was the sum of $243,474 If the company was to earn a return of 8% upon its investment, the following revenue must be provided: 8% return, $19,478; 5% for depreciation, $10,003; operating expenses, $84,819, making the total revenue requirements of $114,300.

The utility estimated that the revenue for the coming year under present rates would be $100,000, with operating expenses of $93,000, leaving available for depreciation and return, the sum of $6,700. The commission allowed for a normal increase of 5% in steam-heat sales and found that under existing rates the utility would not earn a net return of 8%. By discounting the discount rule, the present rates would develop approximately $113,396.

The commission was of opinion that to further increase the steam-heating rates would not only retard development, but would no doubt result in a loss of customers and a consequent diminishing return. The commission, therefore, found that the present steam-heating rates of the city of Grand Forks are not unreasonable and for the present time authorized no change.

A special flat rate of $25 per year for steam service in one building in the city is in effect. It was stated that the piping was so arranged that a meter could not be installed. The amount of steam consumed was apparently estimated. There are two other steam-heat consumers on a flat-rate basis. Under ordinary circumstances the commission does not approve of flat rates, as there is danger of discrimination. In this case; it required the utility to determine by tests the amount of steam heat consumed by each flat rate consumer and require that such consumers be charged the uniform rate found reasonable by the commission. It was expressly understood that where it is possible to install a meter, the utility should discontinue any and all flat rates, either for general lighting, steam heating, or for gas.

The decision, which is dated July 6, 1923, includes various other rulings relating to the property valuation and rates of public utility companies in general.

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## Ordinance Requiring Heating Contractors and Engineers to Be Licensed and to File Bonds Held Invalid

The constitutionality of an ordinance of the city of Detroit passed to regulate the installation of heating and warming systems and apparatus in the city was tested in a suit to restrain its enforcement, brought by a Michigan corporation engaged in selling and installing, as heating contractor and engineer, such heating systems and apparatus.

The ordinance requires a heating contractor to obtain a contractor's license from the Department of Buildings and Safety Engineering, and the filing of a bond of $1,000 for the protection of purchasers of installations, permits for installations, reports of installations by holders of licenses, and other matters. It is provided that the ordinance shall not apply to hotels, hospitals, clubhouses, jails, reformatories or asylums. The Circuit Court of Wayne County held the ordinance unconstitutional because unreasonable, discriminatory and, in certain particulars, arbitrary and oppressive.

On appeal from decree for the plaintiff, the principal defense was that the ordinance was a safety measure for fire regulation to protect the city and its inhabitants against conflagration.

The United States Supreme Court holds, Harrigan & Reid Co. v. Burton, 195 N. W. 60, that, although a municipality, under its general police power, has authority to adopt proper and reasonable ordinances for the prevention of fire and protection of life and property from conflagration as, within reasonable and legal limits, its legislative body may deem a public necessity, municipal ordinances, though ostensibly enacted as public regulations, which are so framed as to control or regulate a common and useful private business or occupation in life, are subject to review and investigation in the courts, to determine their validity by the test of whether, under the guise of a police regulation, there is an arbitrary, unreasonable, or unwarranted interference with the constitutional rights of the private citizen to pursue a lawful business or calling, and to make contracts with others in relation thereto.

"The business of installing heating and warming systems or apparatus in dwellings in the city of Detroit and elsewhere," the court said: "and to make contracts for so doing, is in itself a harmless, useful and necessary industrial pursuit. By this ordinance no person, firm, or corporation can engage in that business in Detroit without a contractor's license, secured from the department of buildings and safety engineering, and filing a bond of $1,000 to indemnify purchasers from it or them of the heating system or apparatus to be installed in dwellings in Detroit. Compelling a bond from the contractor to protect or indemnify the private citizen who chooses to make a legitimate contract with him for the purchase of a heating system or ventilating apparatus and installing it in his private dwelling suggests a measure of paternalism in the ordinary business relations of private parties beyond the natural scope of the police power of a municipality, as intimated in Valentine v. Circuit Judge, 124 Mich. 604. It was there said that even the legislature of this state is 'not empowered by the Constitution to regulate contracts between its citizens who are engaged in legitimate commercial business, or to require any class of persons to pay a fee for the right to carry on business, or to give a bond to perform their contracts which other parties may choose to make with them.'"

Another objectionable feature of the ordinance, as a measure of fire protection exercised under the police power, was held to be that the restrictions and burdens it imposed were directed only against "dwellings," limited further by specially excepting hotels, clubhouses, hospitals, jails, reformatories and asylums, and also left entirely untouched all other kinds of buildings in which heating systems or apparatus of some kind are necessarily installed and used, such as stores, office buildings, restaurants, banks, churches, station-houses, factories, shops, etc. If fire protection was the purpose, it was held that an ordinance which only impose the safeguarding regulations on dwellings, and leaves free to ignore them all other buildings in the city, wherever located, which with their heating systems are likewise subject to the danger sought to be guarded against, savors strongly of discrimination and unreasonable class legislation.

A still more vital infirmity in the ordinance was held to be its uncharted provisions prohibiting all corporations and persons, not excluding the owner, from installing in a dwelling any apparatus or system for keeping it warm without a license, followed by a permit, the requirements for which are not defined, to the exclusion of arbitrary and discriminating official action in granting or refusing it. Application blanks for permits were to be furnished to "holders of contractors' licenses," and they only might install heating plants in dwellings; but no method of application, nor qualifications or standard of fitness, for guidance of the licensing board, were provided, by meeting which the applicant would be of right entitled to a license.

"Reasonable regulations and a uniform rule of action in its determination," the court said; "are essential to the validity of a municipal ordinance. It cannot be left to the arbitrary decision of an administrative officer or board."

Decree for the plaintiff was affirmed.

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**H. Romeyn Smith, Inc.**, is the new name of the business conducted by H. Romeyn Smith, New York representative of the Detroit Brass & Malleable Works, Detroit, Mich. Mr. Smith is president of the new corporation which will retain its warehouse and office at 66 Cliff St.

# Standard Heating and Ventilating Data Sheets Published to Date

Following is a complete index, revised to January 1, 1924, of the Standard Heating nad Ventilating Data Sheets as published by THE HEATING AND VENTILATING MAGAZINE:


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All of the foregoing sheets are available at 5 cents each, or the set complete, with binder, may be had for $13.00 postpaid.

**A. W. Cash Valve Mfg., Co.**, Decatur, Ill., is the newly-incorporated name of the business previously conducted by A. W. Cash. Mr. Cash is president of the new company.

## A Summary of Our Present Knowledge of Air Temperatures, Air Motion and Humidity.

Sometimes the man on the outside is better able to discern the salient points of an investigation or a series of experiments than those directly concerned. An illustration of this is an article by Dr. W. A. Evans, formerly Commissioner of Health in Chicago, which appeared in the *Chicago Tribune* for November 12.

Basing his conclusions evidently on the tests conducted at the Bureau of Mines, in Pittsburgh, he writes:

Conditions of warm air have a powerful influence on the human body, an influence which records itself over a range from heat stroke at one end to grouching at the other.

The three qualities of air which are major factors in producing these effects are: temperature, humidity, and drafts. Sayers and Harrington conducted very extensive experiments from which they obtained the following results:

A. Men at rest in air saturated with moisture and at a temperature of 91½° F. for one hour, with no air movement.

Effects on men:
Increase in body temperature.
Moderate increase in pulse rate.
Profuse sweating.
Dizziness and weakness as after effects.
*With Air Movement*:
Slight or no increase in body temperature.
Slight increase in pulse rate.
Slight perspiration.
No after effects.

No ill effects at any time, but the noise of the fan was complained of.

The conclusion is that when people live in air that is saturated with moisture and is 91½° they will be comfortable if the fans are working or the breezes are blowing.

B. Same conditions, except the temperature of the air was 95.

*Still Air*:
Increase in temperature of the body.
Marked increase in pulse rate.
Very profuse sweating, clothing being saturated with sweat.
Sweat in shoes.
Dizziness on movement.
Rapid respiration.
Chilling sensation.
*Draft of 250 to 600 Ft. Per Minute*:
Slight or no rise in body temperature.
Slight or no rise in pulse rate.
Profuse sweating.
No untoward symptoms.

Conclusion: People can stand saturated air at 95° if they stay in a draft.

C. Some conditions, except air at 98½°.

At this temperature not even moving air made conditions tolerable. In moving air, there was an increase in body temperature, an increase in pulse rate (in one case up to 183), very profuse sweating, dizziness. No work could be done at this temperature.

D. Same conditions, except air at 100.

*Still Air*:
Body temperature rose to 102.3.°
Pulse rate rose to 152 to 175.
Profuse sweating.
Early appearance of dizziness and weakness.

When the air was set in motion (200 to 800 ft. per minute) the people under experiment said they were made more uncomfortable. None of them was able to spend one hour in the room where the hot, wet air was in motion.

The general conclusion is that it does good to use fans when the air is very wet so long as the temperature keeps below 95°. At temperature between 95° and 99°, fanning does very little good, if any. At temperature 100° and over breezes do more harm than good. Working conditions are moderately good where the temperature is under 95°, provided the air is not saturated with moisture and provided there is a breeze.

## Current Heating and Ventilating Literature

*Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from* THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

STEAM TRAPS

TESTING FOR LEAKAGE. Testing Steam Traps for Leakage, L. D. Goff. Steam Power, vol. 2, no. 4, May 1923, pp. 7 and 14, 1 fig. Method for testing traps for steam loss, which is quick and approximately correct. 40 c.

AIR COOLING

Cooling Systems for Buildings, A. M. Feldman. Am. Architect & Architectural Rev., vol. 124, no. 2431, Oct., 24, 1923, pp. 379–384, 10 figs. Describes cooling equipment installed at banking offices of Kuhn, Loeb & Co., New York City, Mt. Sinai Hospital, New York City, and country residence of Paul M. Warburg at Hartsdale, N. Y. 40 c.

CHARTS

The Semi-Logarithmic Chart, Allan C. Haskell. Indus. Management (N. Y.), vol. 66, no. 5, Nov. 1923, pp. 300–301, 5 figs. Use of semi-logarithmic charts to measure relative on percentage variations; their value for showing percentage variations. 40 c.

HEATING, ELECTRIC

Facts About Electric Heating, M. P Whelan. Elec. News, vol. 32, no. 18, Sept 15, 1923, pp. 78–80, 3 figs. Results of special research on application of electrical heating systems to dwellings; sizes of units; energy required; cost of installation; limiting factors. 40 c.

HEATING, STEAM

Analysis of Some Central Station Heating Plant Problems. Mun. & Country Eng., vol. 65, no. 3, Sept. 1923, pp. 101–107. Growth of central-station heating; advantages to consumer; advantages of steam; factors affecting success; location of plant relative to water and coal supply; design and equipment of plant; data on Minnesota plants. 50 c.

## New York Chapter Members Send Gift to Frank K. Chew

Frank K. Chew, editor of the *Sheet Metal Worker*, received a lounging robe from members of the New York Chapter as a Christmas remembrance. Mr. Chew who is slowly recovering from a long sickness, expresses his intention to be "back in the game" very soon.

# Types Of Fuel-Oil Burners For Household Use

*Previous articles in this series are*: 1—*Combustion Fuel-Oil Burners, Sept.*, 1922; 2—*Kleen-Heet Oil-Burning System, Oct.*, 1922; 3—*Ray Rotary Fuel-Oil Burners, Nov.*, 1923; 4—*Victor Automatic Oil Burner, Dec.*, 1922; 5—*Rotary Oil Burner, August*, 1923; 6—*Boston Safety Automatic Oil Burner, Sept.*, 1923; 7—*The Williams Oil-o-matic* 1923; 6—*Boston Safety Automatic Oil*

## VIII—A. B. C. Oil Burner

Among the fuel-oil burners designed for house-heating work, that developed by the Automatic Burner Corporation, 312 North May Street, Chicago Ill., is typical of the class which uses a spinning cup or disc to atomize the oil. This burner gives a widely-spread flame. Its operation will be understood by reference to the accompanying illustrations.

The armature shaft (Fig. 1) by centrifugal force draws the oil through a taper hole up to a cup. Air is taken in through holes in the bottom of the cup. The spinning cup operates to break up the oil, mix it with air and throw it through the atomizer into the boiler as a vapor. There it is ignited by a pilot light. The manufacturer states that the lowest gravity oil that it is practicable to use in an oil burner is atomized by this burner as efficiently as the highest gravity oil.

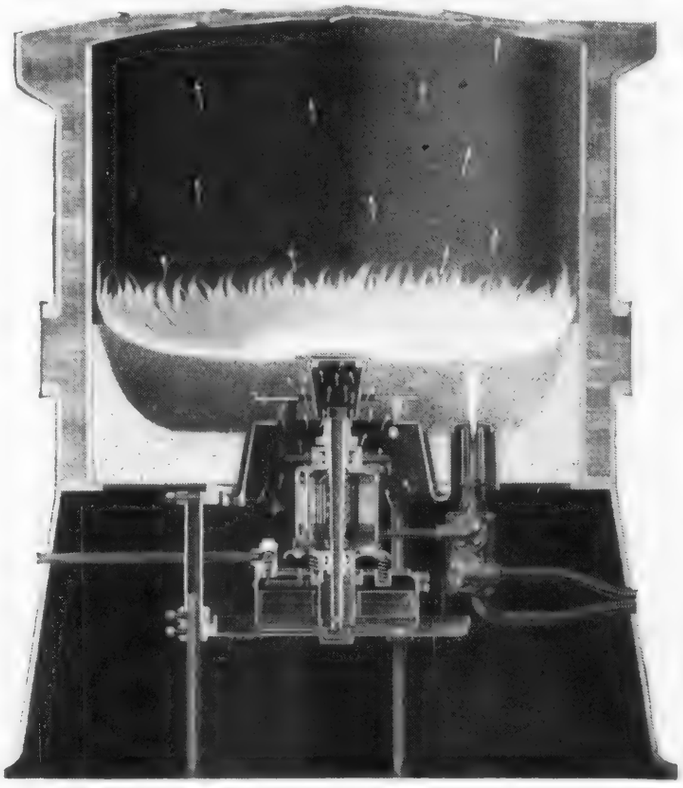

**Fig. 1—Operating Features of ABC Oil Burner**

To make safety doubly sure in measures to stop the oil flow when necessary, a three-ball check is used, each ball having its own seating. Any one of the balls, however, is capable of checking the flow of oil.

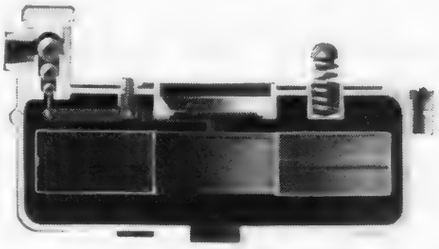

**Fig. 2—Three-Ball Check Valve**

Another feature given prominence by the manufacturer is the automatic adjustment of the burner to any change in the voltage. This, it is stated, is possible because there is no fan or blower, and because the oil and air are controlled by the same shaft. At maximum voltage the armature shaft, which draws the oil up through a taper hole, operates at 10,000 R. P. M. If the voltage is 20% off, the speed is reduced to 8,000 R. P. M. which is not enough to affect the mixture.

The armature shaft and the atomizer cup, it will be noticed, always revolve at the same speed. Thus when the voltage drops, less oil is drawn up and less air is taken into the cup.

The motor used with this burner is similar to those used in industrial bench machines which are designed for high-speed operation. The motor rests on three springs to give it correct alignment, freedom from vibration and quiet operation.

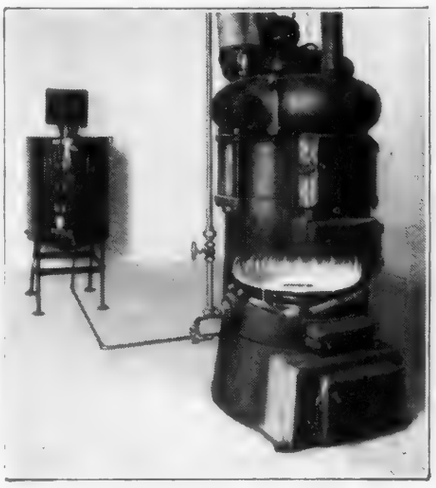

**Fig. 3—ABC Gravity-Feed Burner, with 55-Gal. Tank**

Automatic gas pilot light control is secured through a device shown in Fig. 4. On extinguishing the pilot light the two claw-light pieces of metal contract. The tension spring jerks them down, stopping the motor.

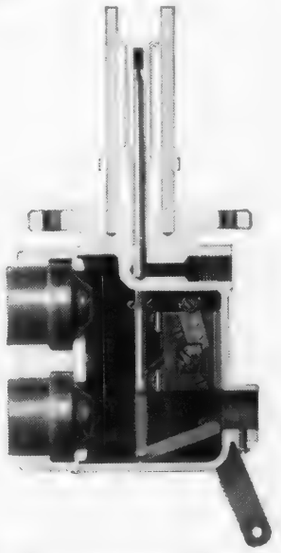

**Fig. 4—Automatic Gas Pilot Light Control**

This system is intended to operate in connection with a thermostat. For those who prefer a pump feed burner, permitting the use of a large reserve oil tank, the company supplies two types, a hand pump and an electric pump.

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WILLIAM J. HAYNES, president of the Haynes-Langenberg Manufacturing Co., St. Louis, Mo., died suddenly at his home in St Louis recently. Mr. Haynes, who traveled overland in a private schooner to St. Louis in 1879, was born in Mount Airy, N. C., March 16, 1851.

### Precautions to be Taken in Connection with the Furnishing of Temporary Heat.

In view of the fact that the operation of temporary heating plants was definitely placed in the jurisdiction of steam fitters recently by the National Board for Jurisdictional Awards, unusual interest attaches to a discussion of this subject at the meeting of the Board of Directors of the Heating and Piping Contractor's National Association, December 4, at which the secretaries of state and local associations were present. As reported at the time in THE HEATING AND VENTILATING MAGAZINE for October, 1923, the action of the National Board refers to low-pressure heating plants and its decision was the outcome of the arguments that arose because the Board had previously awarded this work to the stationary engineers.

It was brought out, at the meeting of the heating contractors, that the members of several local associations are using with good results the following form, in such cases, to which they obtain the signature of the owner before the plant is turned over to him or his agents for temporary use:

Messrs. Blank & Blank,
Steam Heating Contractors,
Gentlemen:

In consideration of your permission to use, previous to its completion, the heating apparatus now being installed by you in the building of . . . at . . . the undersigned hereby agrees to place a competent person in charge of said heating apparatus, and be responsible for its care and for any damage done to or by said apparatus until such time as its use is discontinued and the apparatus returned to you in as good condition as it is received by the undersigned.

Very truly yours
(Signed) . . . . .

In some cases the matter of temporary heat is taken up in the proposals or made a part of the specifications and contract. In such cases the clause here given, continues the *Official Bulletin*, will undoubtedly save the heating contractor a great deal of argument and expense:

"Temporary Use of the Apparatus.

"Should you or your agents, contractors or others acting under them, desire to use any part of this apparatus prior to its acceptance, permission is hereby granted under the following conditions: That the apparatus is to be operated entirely at your risk and expense and delivered to us again in as good condition as found. If temporary radiators are required, an extra charge for labor will be made for each radiator connected."

These two forms are taken from the files of the Heating and Piping Contractors' New York City Association, similar blanks being used in several other associations.

### The American Radiator Company Building

An event that cannot fail to greatly increase the prestige of the heating industry, especially in the minds of the general public, is the erection of the new home of the American Radiator Company, at 40 West 40th Street, which will be ready for occupancy May 1. The building, in its completed form, is shown in the accompanying illustration. An idea of its size may be gained from the fact that it will contain 77,000 sq. ft. of floor space, 22,000 sq. ft. of which will be occupied by the American Radiator Company's executive offices and New York sales branch, including extensive showrooms on the ground floor. An interesting feature is that over 90% of the floor space is within 25 ft. of the windows.

A daring departure from the conventional in office building construction has been carried out in the design of this building. Unlike any office building in the country, the new structure will be faced entirely with black brick, with golden-colored stone trimming, worked together to give a rich black

**American Radiator Company's New Building in New York**

and gold decorative effect. The building has already provoked wide discussion in professional circles because of its unique design.

Raymond M. Hood, architect, associated with John M. Howells, who took the first prize for the *Chicago Tribune* Building in the international competition held last year, designed the building. Of its unique features, Mr. Hood says:

"The radical departure from standard practice arose from a feeling that so many office buildings are monotonous if not ugly. Monotony and ugliness in office building seems to come from the fact that the windows are actually black holes, and the regular spacing of these black holes makes a building look like waffles or door-mats hung up to dry. The solution to this problem lay in finding a color of wall that would tie together the black holes, and make them less apparent, but, as the building progressed, we found it struck a very cheerful note. The idea for gold trimming came next and caught the fancy of us all. Precedent, at least in Europe, pointed to other periods of architecture where black had been used effectively, particularly, for example, in the Grande Place of the Hotel de Ville, Brussels. In Pompeii, also, and in France at the time of the Empire, whole rooms were done in black with only a slight relief of color.

"We felt that the old problem in office building design demanded a new solution and that, just as other architects have broken away from conventional treatment in certain directions and raised the standard to higher levels, we might contribute a new plan of coloring which would make for progress."

The building was erected by Hegeman-Harris Company, Inc., builders, and occupies a plot 77 ft. front by 100 ft. deep. It is estimated that the building, including land, when fully completed, will cost in the neighborhood of $2,000,000.

Cross & Brown, 18 East 41st Street, have been appointed renting and management agents.

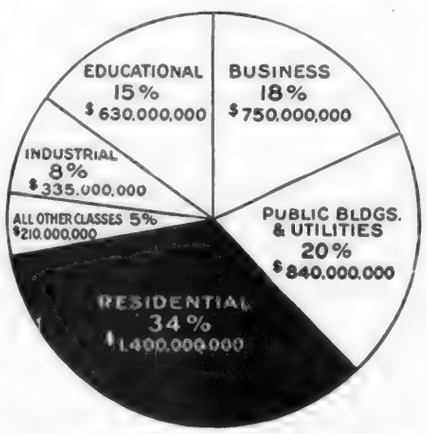
### 1924 To Be Another Big Construction Year

While final figures on the 1923 volume of building are not yet available, it has been established that actual construction ran well above $4,000,000,000. And while observers differ some in minor degree all seem agreed that the 1924 building pace will continue equal to or greater than that of the past year.

Actual construction reports from the greater part of the United States, according to the F W. Dodge Corporation, fix the value of 1923 building in excess of $3,990,000,000. John B. Carrington, editor of *Architecture*, has estimated that approximately $32,707,300 was spent in 1923 for heating and ventilating equipment in business buildings, without taking account of residences, hotels, public and miscellaneous buildings.

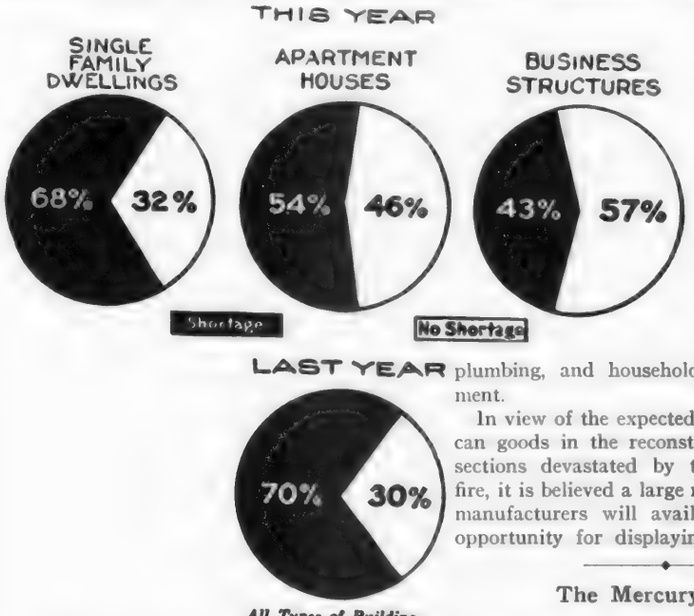
This same authority, estimating the 1924 building at approximately $4,165,000,000, divides the construction as follows: 34%, or $1,400,000,000, residences; 20%, or $840,000,000, public buildings and utilities; 18%, or $750,000,000, business buildings; 15%, or $630,000,000, educational buildings; 8%, or $335,000,000, industrial building; and 5%, or $210,000,000, all other classes.

Rents continued to mount in many sec-




**Where the Money Will Go in 1924**

tions of the country, a survey of New York City disclosing an increase of from 40% to 93% since 1919. Nationally, however, it must be concluded from reports available there is indication that a renting level has been reached at which prices tend to stabilization. The greatest demand, practically everywhere, continues to be for single dwellings. Building material and labor costs mounted during 1923, thus combining to




**Percentage of Cities Reporting A Shortage of Buildings in 1923 as Compared to 1922**

make the cost of single dwellings beyond the means of most in need of such homes.

"Contemplated new work reported in 1923" the F. W. Dodge Corporation announces "amounted to $7,421,940,000 in 36 eastern States, comprising about seven-eighths of the country's total construction. This is 86% in excess of total contracts awarded or work actually started. The normal excess is about 50%, which may be taken to as an indication of a demand that has not been fully satisfied."

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WHEN THE ELECTRIC FURNACE MAN IS IN THE CELLAR is the title of an envelope-size folder issued by the Domestic Stoker Co., New York. The "Electric Furnace Man," the folder explains, is an electrically-operated device which performs the work ordinarily done by the "furnace man"—putting the coal on the fire, keeping the fire burning and taking away the ashes. The device, which may be attached without difficulty to any ordinary steam, hot water or warm-air furnace, makes it possible also to use the cheapest sizes of coal.

C. J. TAGLIABUE MFG. CO., Brooklyn, N. Y. announces a new method of thermometer-tube construction known as the TAG-Hespe red reading column. A broad red line shows from the top of the mercury column to the top of the tube. When the mercury rises it covers more of this red line; when it falls, a correspondingly greater length of the red line is exposed. Use of the red line, it is claimed, serves to attract the eye and makes reading easy. Since the feature is applied to mercury thermometers, no sacrifice of accuracy, has been necessary.

## American-Made Goods To Be Exhibited in Tokio

The Japan Society of Heating and Refrigerating Engineers (Dambo Reizo Kyokwai) has announced that an exhibition of American-made building construction and equipment materials will be held in Tokyo early this year. The exhibition will include heating, ventilating, refrigerating, sanitary plumbing, and household and office equipment.

In view of the expected demand for American goods in the reconstruction of Japanese sections devastated by the earthquake and fire, it is believed a large number of American manufacturers will avail themselves of the opportunity for displaying their products.

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## The Mercury Boiler.

Not only the technical press, but the newspapers as well, have reflected the extraordinary interest aroused in the development of a boiler in which mercury takes the place of water and mercury vapor, the place of steam. Such a boiler and turbine, as developed by W. L. R. Emmet, of the General Electric Company, has been actually placed in operation at the Dutch Point Station of the Hartford Electric Light Company. It has been operated several times and has carried as much as 1500 K.W. It is predicted that the boiler can soon be placed in commercial service.

Development work on a boiler using mercury has been going on since 1914, when Mr. Emmet first took up the work. The process provides for the vaporization of mercury in a boiler, expanding the mercury vapor through a turbine and utilizing the heat of exhaust to generate steam, which is put through a separate turbine or supplied to the station main, as in done at Hartford. By carrying a high degree of superheat of the mercury vapor, the thermal efficiency approximates that of an internal-combustion; that is, a kilowatt-hour is generated at about 11,000 B.T.U.

According to Mr. Emmet, the mercury boiler, with mercury at 35 lbs. gauge, will give 52% more output in electricity per pound of fuel than a steam-generating turbine plant, running at 200 lbs. pressure.

The only pump in the system is a vacuum pump of the water-seal type which sucks through a canton-flannel screen. Every joint in the system is welded to avoid any possible leakage of air or mercury vapor.

The mercury boiler as at present developed is of the vertical type, cylindrical in form, and has a single tube sheet, into which the tubes are expanded and then welded. The lower ends are free to expand. The present boiler holds about 30,000 lbs. of mercury and is designed to evaporate 230,000 lbs. of mercury per hour. At this rate the turbine would develop 1900 K.W. and deliver about 28,000 lbs. of steam per hour at 200 lbs. and 100% superheat. Other features of the equipment include a mercury condenser and a mercury sump which is under a gas seal.

The present design is considered as merely a step in the development of the mercury boiler and already, it is announced, modifications are being made in the design.

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## Alexander Forward Appointed Manager of American Gas Association

Alexander Forward, a former newspaper man and member of the Virginia State Corporation Commission, has succeeded Colonel Oscar H. Fogg, as secretary-manager of the American Gas Association. Mr. Forward assumed the duties of the position January 1, Colonel Fogg having accepted a position as president and general manager of a gas appliance manufacturing company in Baltimore, Md.

Mr. Forward comes to this important post with a wealth of experience in the gas field. After serving as secretary to Governor Henry Carter Stuart of Virginia during the trying period of the World War, he became a member of the commission which regulates public utilities in Virginia. Early in 1918, however, he had obtained leave of absence to engage in war service, serving as director of relief supplies for the Balkan States.

**Alexander Forward**
New Secretary-Manager of the American Gas Association

His ability in the field of regulation was quickly recognized and resulted in his successive election as second vice-president and first vice-president of the National Association of Railway and Utility Commissioners. He also was chosen as chairman of the executive committee of that organization and probably would have been elected president at the recent convention in Miami, Fla., but for his engagement with the American Gas Association.

He was re-elected a member of the Virginia commission in November 1923 by a majority of 88,742 over an independent candidate.

# Improvement In Sight But Not Here Yet

## Cautions Against Increase In Nations Industrial Equipment And Multiplication Of Industrial Enterprises

Especially Prepared for THE HEATING AND VENTILATING MAGAZINE

***By L. W. Alwyn-Schmidt***

THE slight improvement noticed during December has not continued during January but most likely will reappear more pronouncedly during February and March. The reason for the present quietness probably is that only a few of the nation's industries have felt, until now, the influence of the new buying movement, while others still are running below the level of the second half of 1923. Economic progress does not come at once in all industries.

Experience, in fact, shows that every new buying movement appears first in such fields that happen to be especially susceptible to the influx of new buyers. Hence the industry which happens to be in its so-called season will invariably notice first the signs of improvement. The strength of the buying movement extends later to other industries as their buying season comes around. According to this rule, and it seldom fails, the agricultural implement industry, the clothing industry, the cotton industry, and the electrical equipment industry, should be next in line for an increase in business.

Manufacturers should approach cautiously any increase in volume of orders. The forecasting line of our chart indicates a nervous market, and readers will be well advised to remember that the new forward movement, if it materializes, is built upon a market which, while thoroughly healthy in structure, has run on rather high figures in the past.

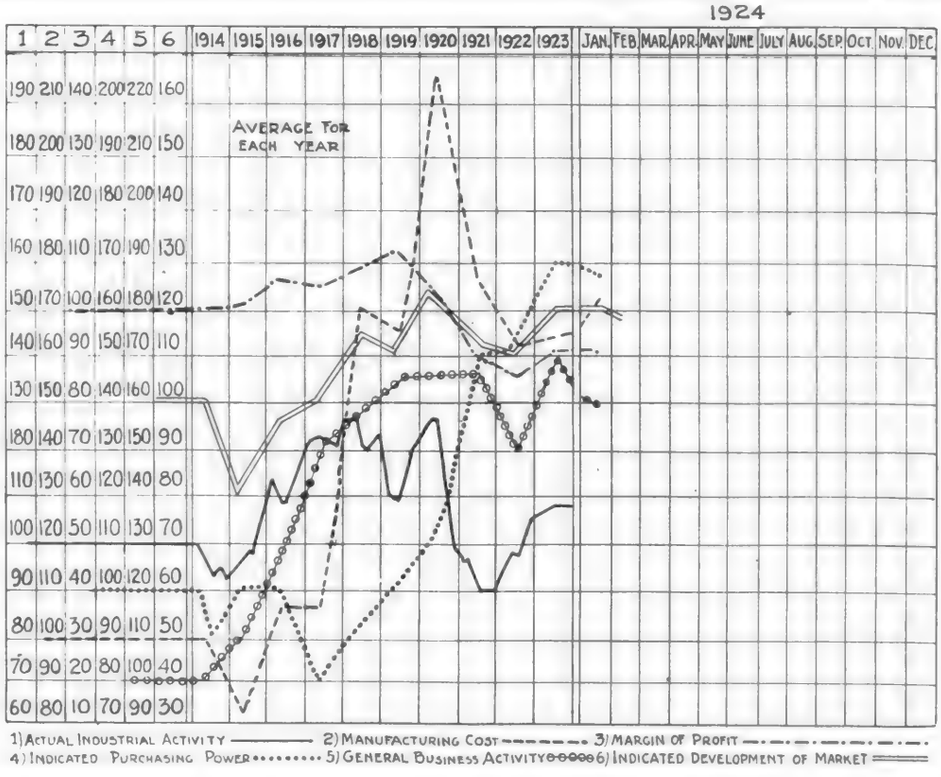
Under such circumstances the volume of purchases must be very considerable indeed in order to produce a marked effect upon the total turnover of merchandise. It would have to be exceptionally large to justify an increase in the nation's industrial equipment or a multiplication of enterprises. Careless expansion of this kind has been principally responsible for the industrial debacle after the war. There is no reason to repeat this experience after it has proven so disastrous to our industrial life only a short while ago.

Thanks to the quick action of the banks, industrial inflation was stopped early last year by a strict censure of all industrial credits. It is to be hoped that similar action will not be required during the present year.

While in this manner expansion and multiplication cannot be sufficiently enough discouraged there is on the other hand reason to advise manufacturers to keep themselves ready for a 100% utilization of their present equipment. True, we are passing through a season of slackness following a short period of overproduction during October and November when the flattening-out tendency of the market was not yet realized fully by all manufacturers. But the accumulation of stocks caused in this manner will correct itself automatically and we may expect an opening of the channels of distribution at an early date. The correctness of this statement is borne out by the fact that merchants who have kept their stocks low during the Christmas season, are now placing orders freely.

There are two reasons leading one to expect that the present nervousness of the market will be of a passing character only. One is the still very high purchasing power of the nation as a whole, the other is the more specific news that the farming community has not been affected so severely by the rural depression as had been expected originally. The principal problem in consequence seems to be to determine when we may expect the approach of the new buying movement.

Winter is very late this year and there are some who now predict a late Spring. This would put seeding time later in the year than usual and might in this way defer the return of the farmer in the market. As the farmer's buying releases always a large amount of ready cash this delay would




**Analysis of Business Conditions at End of January**

prove rather inconvenient for our manufacturers as it may cause difficulties in realising on Spring sales.

How can this situation be taken care of by an intelligent handling of the credit situation? There has been in former years a tendency to induce retail buying by a system of extended credits. While such a practice will work well in an active market it may, however, easily lead to embarrassments whenever the market enters a downward grade. In such a case it overloads the retailer with merchandise upon which he cannot realize, only making payments difficult but clogging up, at the same time, the manufacturer's channels of distribution. The better way in a situation such as the present one must be to encourage numerous small sales over a widely diversified field, permitting, in this manner, a rapid turnover of cash and merchandise. This in turn means short credits and the encouragement to take the discount.

In presenting this month's report and chart the reader's attention is drawn to the slight change made in the system of recording. This has been done for the purpose of bringing the various lines in the same relation to each other, each moving upon the same scale of ten degrees to each horizontal line. For convenience's sake the former system of giving to each line its own scale has been retained. The hundred-point has been laid in each instance so as to bring the full line inside the recording field of the chart. The continuity of each line has been broken on the double vertical line separating the yearly averages from the monthly record of the new year 1924. These changes have been made on the suggestions of several readers which kind interest is herewith gratefully acknowledged.

## Precautions To Be Taken To Prevent Carbon Monoxide Poisoning from Gas Stoves

A recent report by a consulting gas expert states that there are over 2,000 natural gas-using towns and over 4,600 manufactured gas-using towns in the United States, and that gas is used by over one-half of our population.

Artificial gas, it is stated, creates a double hazard since carbon monoxide is an important component and therefore death may result from simply breathing it, as from unsuspected leaks. Natural gas does not contain carbon monoxide nor other readily toxic ingredients, but if burned incompletely, as most frequently happens from a poor or defective air mixer on a gas stove built on the Bunsen principle, will readily yield death-dealing amounts of the gas. So also will any carbon-containing fuel. In this respect the cigar, cigarette and pipe are common illustrations, one authority stating that the habitual smoker shows as much as 6% saturation of his blood with COHb. About 25% saturation produces symptoms in the average person; 50% will produce unconsciousness, while 75% usually produces death. As small an amount as 1/10 of 1% in the air may ultimately prove fatal because of the affinity of the gas for the red corpuscles which is some 300 times that of oxygen, by which a slow displacement ending in asphyxia results.

The unusual increase, at this time, in the incidence of mishaps is said to be due to the appearance of the "radiant" type of domestic heating stove which, according to Smithsonian Institution Bulletin 102, No. 8, is likely to produce carbon monoxide gas whenever the radiants glow over three-fourths of the distance from the bottom to the top. Hence a slight increase in gas pressure, as usually occurs overnight, due to lessened general use of gas, may easily change a stove, operating innocently enough in the daytime, to a carbon monoxide generator in the middle o. the night. This is borne out by the act that most of the mishaps occur overnight in bed rooms (in which windows are also closed).

It is noteworthy too, that the size of the room has little significance in the end as some Ohio mishaps occurred in large rooms open to each other and even in stores during business hours.

Furthermore, investigations by the Ohio State Department of Health and the United States Bureau of Mines have shown that some of the cheaper heating stoves placed on the market are inherently defective and yield death-dealing amounts of carbon monoxide under regular conditions of normal gas pressure even when burned according to directions accompanying them.

(Attention is also called to the use of gas-fired water heaters of the instantaneous type commonly set up in bath rooms, kitchens, etc., without a chimney attachment and the comment is made that in such cases water heaters are especially dangerous because carbon monoxide is yielded whenever a carbonaceous flame touches a cool surface).

Another phase of the question is the keen competition between manufacturers of gas stoves which has resulted in constantly cheapened products with wide variations from the fundamentals of safe construction laid down by the United States Bureau of Standards. Still another is the fact that distributors and retail dealers are said to remove the warning labels in many instances which are attached by the manufacturer, which labels proclaim danger unless the devices are adequately ventilated when set up. However, it would seem easy, in this contingency, to stamp or impress the warning label into a conspicuous part of the stove. Furthermore, building laws requiring permanent types of chimney construction, such as brick, etc., for all smoke flues (underwriters usually place the flue for gas stoves under this heading) offers another serious block to remedying the situation, both in buildings already constructed as well as the expense of extra chimneys in new construction.

### OUTLET PIPES FOR GAS BURNERS

While placing the gas stove in the fireplace or equipping it with a hood and outlet pipe does not always guarantee its safety (because of faultily constructed or blocked-up smoke flues, or, indeed, reverse drafts which sometimes occur in chimneys), such is the best-known safeguard at the present day. Experience shows that it is useless to repeat that plenty of room ventilation will suffice since, on cold days, people insist first on comfort. Or even to repeat that a person is a fool for sleeping with the windows closed and a fire burning in his sleeping room. This does not solve it for the bath room, or the hotel room over which one may have no control.

*Do not use without adequate flue ventilation* should be the slogan for all types of gas-fired room heating devices, to which should be added the instantaneous water heater.—E. R. Hayhurst, M.D., consultant Division of Industrial Hygiene, Ohio State Department of Health, in the *Journal of Public Health*.

## Air Conditions in Railroad Tunnels

Owing to several factors, CO, which is not a hazard to engine crews in eastern tunnels is one of considerable importance in those of the west. Average cab temperature of 24 trains passing through the Aspen, Wyoming, tunnel was 114° F. dry-bulb, and a relative humidity of 90%. The maximum dry-bulb temperature reached 136° in one of the tests.

Of 40 trips conducted in cabs of locomotives while the trains were passing through tunnels CO was found to be present on 34 trips; of these, 21 tests gave 0.01% to 0.10% of CO, 8 tests gave 0.11% to 0.20%, and 5 tests, 0.21% to 0.35%. Blood saturation of 5% to 18% was demonstrated in subjects.

High temperatures and humidities and the presence of smoke and gases might cause asphyxiation or exhaustion in a period of twenty minutes, especially if the engine were stalled.

While protection against smoke and sulphurous gases was afforded by pocket respirators, CO masks protected against all gases, but the use of gas masks is of doubtful application in this case because of the discomfort caused by altitude, high cab temperatures and humidity.

However, a practical source of breathing air was found in the air-brake line, and this, used in combination with the train air-tanks, will afford a supply of pure air which will last thirty minutes. A rubber hose attached to an ordinary funnel is connected to the air-brake pipe line. The trainman holds the funnel to his face, regulating the air supply by a small orifice and valve. Cab temperatures were reduced 20° to 30° by the use of a locomotive smoke deflector.—S. P. Kinney, *Reports of Investig.*, U. S. Bureau of Mines, Serial No. 2494, June, 1923.

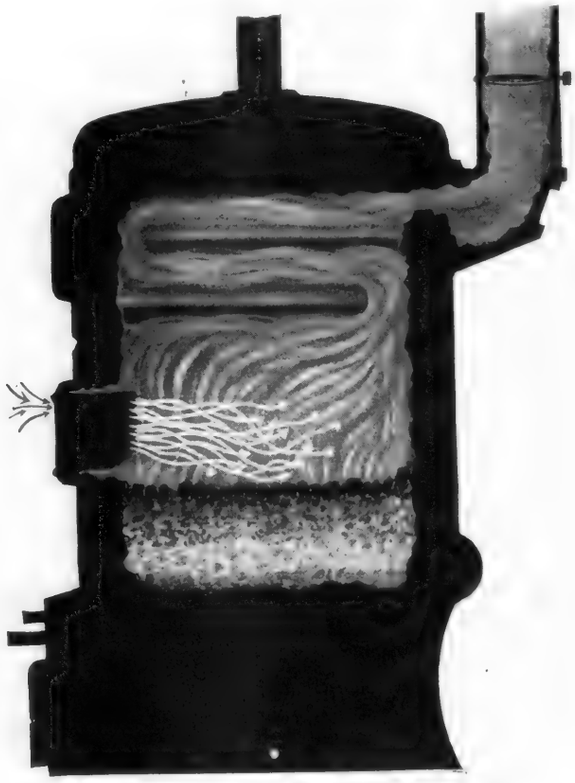
## Deaths

FRANCIS J. FURLONG, of Furlong, Whittemore Co., Boston, died at Carney Hospital, Boston recently following an operation. He was 56 years old and was well known to the heating trade of Boston. He had been a member of the Heating and Piping Contractors Boston Association since 1918. A widow, four daughters and two sons, survive.

MINNEAPOLIS HEAT REGULATORS form the subject of more than a score of proofs of newspaper advertisements assembled in a handy folder for distribution to dealers and just issued by the Minneapolis Heat Regulator Co., Minneapolis, Minn. The folder calls attention of dealers to the company's national advertising campaign and recommends that dealers select some of the proofs submitted and place them in local newspapers to get the best benefit from the magazine copy. Cuts of the advertisements, it is stated, will be furnished to dealers without charge. Size 8 x 11 in., folded.

### The Combusto Draft System.

Among the various devices on the market for preheating the air above the fire-bed of a coal heater, that comprising the Combusto draft system is being featured as not only an air preheater but a method of draft control, performing the same function of air adjustment for the boiler furnace as is accomplished by the "turn screw" air adjustment of the Welsbach gas mantle, or the venturi opening in the gasoline carburetor. The device itself, which is intended to be attached to the feed-door of a heater, is a box-shaped casting made of gray malleable iron, having inside individual compartments differing in number according to its size and the work it is called upon to do.

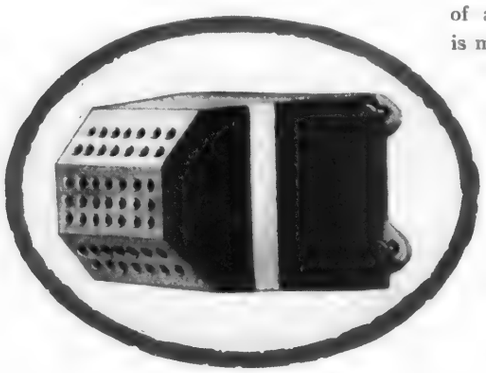


**Combusto Draft System in Operation**

As designed by Herbert Brunner and now being marketed by the Combustion Specialties Co., 320 West 48th St., New York, the Combusto draft system is intended to deliver the correct quantity of air over the fuel bed, to deliver this air in the form of a spray so that it will be distributed evenly over the top of the fuel bed, and to deliver this air at exactly the right height from the top of the fuel bed.

In operation the preheated air has to pass through the different internal compartments of the Combusto, coming out through the numerous holes in what is described as a spray, shot evenly over the top of the fuel bed.

In a report on this device, made after an investigation of its operation in some twenty-three plants in which various types of heating systems were used, Walter S. Timmis, Consulting Engineer, of New York, pays tribute to its usefulness, stating that it has been found to provide means for supplying the necessary diffused and heated air over the fire to properly complete, in the second stage, the combustion begun in the fuel bed by distillation of gases. One of the important features of the device, he adds, is the resistance to the flow of air through the apparatus itself, which is made to practically equal the resistance of the fuel bed, thus producing a balanced condition above and below and through the fuel bed. Mr. Timmis concludes with an expression of his belief that the device is capable of great development in practically any type of heating furnace or boiler, being especially applicable in cases where loads are light and the time between firing periods is of long duration.



**A Typical Combusto Unit**

### Electric Contact Type Temperature Controller

An electric-contact type temperature controller has been added to the line of indicating, recording and controlling instruments manufactured by the C. J. Tagliabue Mfg. Co., Brooklyn, N. Y. The new device consists essentially of a dial-indicating thermometer, the pointer of which is actuated by the usual mercury vapor-tension or gas-filled thermostatic system. The bulb stem is inserted in the oven, furnace, tank or other place where the temperature is to be controlled and is connected by a capillary tube to the case which can be mounted at any convenient location. The new controller may be used also, the manufacturers state, for starting and stopping a motor by means of a motor-starter, as in the case of an automatic refrigerating unit.

**Electric-Contact Type of Temperature Controller**

### New Chicago Vertical Condensation Pump.

A new vertical condensation pump has recently been added to the lines of pumps sold by the Chicago Pump Co., Chicago, Ill. The new pump, it is explained, is installed in the ground and handles the condensation from return lines that come back below the floor level, pumping the hot water into the boiler. Special features of the new pump are that the outfit is self-contained, being shipped as a unit ready for installation; all flanges are machine-finished and assembled to prevent steam leaks; special oil-less bearings are used to stand up in hot water without lubrication; and a special float mechanism, guaranteed not to leak or stick in stuffing boxes.

ANALYSES OF OHIO COALS has just been issued as Technical Paper 344 by the Department of the Interior, through the Bureau of Mines. It is the third of a series of papers issued by the bureau which contains information regarding the coals of the different States. The two previous papers (269 and 308) related to Iowa and Kentucky coals, respectively. The present report gives first place to the Middle Kittanning coal bed which is characterized as the most important in Ohio, with the Pittsburgh coal bed a close second. A description is given of the room and pillar plan of mining coal

which is the method generally used in Ohio. There are two principal fields, the northern which produces about 65% to 70%, and the southern, producing about 35% of the State's total. About 40% of the total output is consumed within the State.

# New Trade Publications

BETTER VENTILATION AT LESS EXPENSE is the title of a striking booklet just issued by the American Cornice Works Co., Wichita, Kan., manufacturers of the Buckley multi-syphon ventilator. An introduction to the book asserts that America is an under-ventilated nation and is badly in need of an intensive campaign for "better ventilation for the nation." The ventilator is especially designed for schools, residences, theatres, apartments, hotels, offices, factories, foundries, restaurants, packing houses, garages, oil refineries and tile and brick plants.

UEHLING CO RECORDER, designed for use as a separate instrument or as adjunct of the $CO_2$ Recorder, is described in a new circular issued by the Uehling Instrument Co., Paterson, N. J. The CO recorder, it is stated, discloses when there is too little air just as the $CO_2$ recorder tells when there is too much air.

HOW TO BUILD A BETTER HOME is the title of an attractive booklet issued by the Copper and Brass Research Association, New York. Of major importance in erecting a home, the booklet states, is the installation of a furnace or boiler, large enough for the demands of the home. Heating is a major item of expense and it will pay home builders to master every detail of the heating subject. The association urges the use of copper weather-stripping so that the furnace need not shoulder the big handicap of air leakage. The association, which is located at 25 Broadway, New York, invites correspondence from architects, contractors and individuals who contemplate building a home.

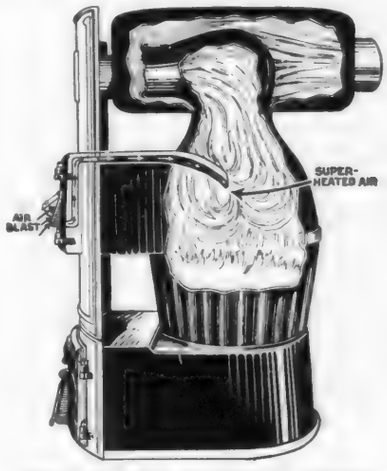
FOXBORO CO., INC., FOXBORO, MASS., has issued Bulletin No. 96—1, the company's second general catalog. The bulletin present briefly though fully the different types of indicating, recording and controlling instruments manufactured under the Fozboro trade-mark. Each instrument treated in the catalog is illustrated and thoroughly described in the accompanying text. Attention is called in the catalog to the fact that Foxboro instruments are not assembled but are built entirely in the company's factory by trained craftsmen. 4 x 9 in. Pp. 24 and cover.

BLUE SEAL IRON CO., Wisconsin Rapids, Wis., has issued a twenty-page instruction book discussing the various uses of Blue Seal iron and its application.

ILGAIR CURRENTS for January, 1924, the bimonthly periodical of the Ilg Electric Ventilating Co., Chicago, Ill., contains an interesting article on the company's sales offices in the South. The article, written by G. C. Breidert, manager of sales promotion, recounts the writer's impressions of conditions as reflected from visits to dealers and jobbers, with particular reference, of course, to the fan business.

ROTARY OIL BURNERS are described and illustrated in a folder recently issued by the Pennsylvania Globe Rotary Oil Burner Co., Philadelphia, Pa. Rotary oil burners, the folder points out, are designed for all furnaces —warm air, hot water and steam. The burner, it is stated has demonstrated its safety and dependability in thousands of household installations on the Pacific coast and has received the approval of fire marshals wherever it is used.

HERO PATENTED AIR-JET is a new device manufactured by the Hero Furnace Co., Sycamore, Ill., and described in a folder recently issued by the company. The Air-Jet was designed, the manufacturers state, to inject a stream of air over the fire bed at such a high temperature as to permit instantaneous and perfect union of oxygen and carbon The Hero method takes the air in through the feed door and conveys it to a point over the fire bed through a flat cast-iron duct at the top of the feed chute. Since offering the product to the trade, the company has improved it by casting the feed-door lining in a solid plate with an open mouth at the top. When the door is closed this makes a close connecting joint, with a cast-iron bolted at the top of the feed chute. The new air-jet, it is claimed, makes possible the burning of low grades of fuel efficiently and without smoke.




**Hero Air Jet Applied to Warm Air Furnace**

DAVIDSON PUMPS, steam and centrifugal, manufactured by the M. T. Davidson Co. Brooklyn, N. Y., are presented in an attractive catalog recently issued, comprising a bound volume of various bulletins previously published by the company. Numerous tables, showing contents of cylinders and conversion figures, are included for each of the many types of pump produced by the Davidson company. The catalog also contains numerous illustrations of the product. While more than a score of pumps are described, the following are a few of the types presented in detail; air pumps, ammoniacal liquor pumps, artesian well pumps, automatic feed pumps, circulating pumps, elevator pumps, filter press pumps and gas works pumps. The company manufactures a pump for practically every use. In addition, the catalog presents detailed directions for the care and operation of the pumps and describes the various adjustments and parts which may be used in connection with the pumps. Size 6 ½ x 9 in. Pp. 64 and cover.

HEATING COMFORT is the title of a pamphlet issued by the United Utilities & Engineering Corporation, Philadelphia, Pa., manufacturers of the Heatomat gas boiler. The Heatomat is a cast-iron sectional boiler, joined together with cast-iron nipples and held in position with heavy through rods. The hot gases from the combustion chamber are directed in a circuitous path to the preheater by a series of baffles, thus furnishing an unusual amount of heating surface. Waste gases are utilized for preheating the water returning to the boiler and the waste gases from the preheater may be further utilized for heating a domestic hot water coil, placed above the preheater and connected to a hot water storage tank. A Heatomat positive thermostat, centrally located in one of the rooms, makes it possible to regulate the temperature to all kinds of weather.

BUFFALO FORGE CO., Buffalo, N. Y. has issued a new catalog covering its line of forges, exhausters, drills and punches. The company has been producing forges since 1877 and has representatives throughout the United States, Europe, Asia, South America and other foreign countries.

BURN-BUCK BLOWER APPARATUS for attachment to furnaces, manufactured by the Burn-Buck Co., Philadelphia, Pa., is presented in an envelope-size folder. The apparatus is a simple device, operated by a small electric motor, designed to increase the combustion and to permit the use of the cheaper grades of coal. The device can be installed easily and may be readily removed in case the owner changes his residence.

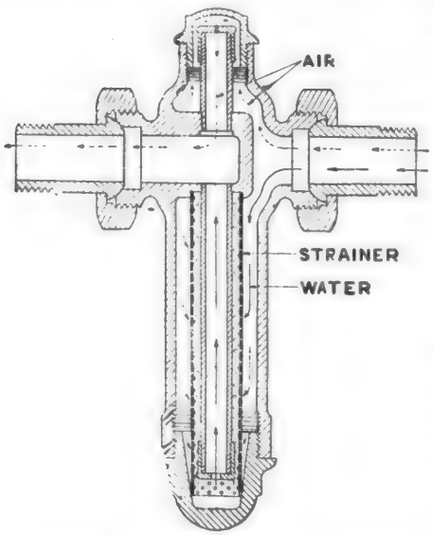
WHEN THE JANITOR GOES HOME is the title of a little folder published by the Standard Heater Co., Williamsport, Pa. The Spencer heater includes a magazine that holds a supply of No. 1 Buckwheat coal sufficient, in ordinary cold weather, to last 24 hours. This coal automatically feeds into the fire as it is consumed, while the ashes are forced to the foot of the grate. The heater permits the maintenance of an even, uniform heat for 8 to 10 hours without attention.

VOLUNTEER STEAM AND WATER BOILERS are described in an illustrated bulletin issued by the Wm. H. Page Boiler Co., New York City. Sectional and front views of the Volunteer boiler are shown and a table of ratings and measurements given for the Volunteer round boilers.

RICHARDSON VAPOR - VACUUM - PRESSURE HEATING SYSTEM, adaptable either for new heating plants or for use in connection with systems already installed, is described in an illustrated envelope-size folder recently issued

by Richardson & Boynton Co., New York. The Richardson system, it is pointed out, permits as much or as little heat in each radiator as is desired. It is described as automatic and economical, both in installation and operation. The folder presents typical illustrations of installations in residences, apartments, churches, schools, factories and public buildings in various parts of the country.

MASTER VAPOR-VACUUM-PRESSURE SYSTEM OF HEATING, devoted mainly to the Master automatic return-line valve for vapor systems, is the title of a catalogue issued by Thomas F. Dexter, 50 Church St., New York. In addition to a Master graduated radiator supply valve which opens or closes with a quarter turn, the system includes a Master air expeller and vacuum trap, placed at the end of each air-line return in the cellar, near the boiler, taking the place of air valves on the radiators. It is designed to automatically release all the air from the system, but to close by expansion as soon as steam or vapor reaches it, thus preventing waste heat and air from coming back into the system. Easily the most interesting feature of the system, however, is the Master automatic return valve, placed at the return end of each radiator and




**Master Automatic Return Valve**

designed to prevent steam flowing through each individual radiator or coil without first having conducted to the heating system all the heat it should have emitted, and dispensing with the air and water of condensation as soon as it is formed, at the same time preventing any short-circuiting throughout the system where it is applied. As will be seen from the accompanying illustration, there is a small hole in the top of the tube through which the air and gases are expelled from the system. This arrangement is likened to that where the ordinary air valves on a radiator is left open, allowing steam to flow through all parts of the radiator. A point is made of the fact that the valve has no moving parts and is entirely automatic in operation. Size 6 x 9 in. Pp.8.

TURBINE BLOWER EQUIPMENT FOR HAND AND STOKER-FIRED BOILERS are discussed in a 24-page booklet, prepared by the L. J. Wing Mfg. Co., 358 West 13th St., New York; it will be found of interest to all who have use for forced-draft equipment. It contains considerable engineering data, not only on the application of these blowers to hand-fired boilers, but also goes into considerable detail in discussing the application of the blowers to underfeed and chain-grate stokers, showing how they may simplify stoker installation. The booklet is well illustrated. It is now ready for distribution.

WEATHER VEIN, Vol. 3, No. 7, published by the Carrier Engineering Corporation, Newark, N. J., devotes the greater part of the first 1924 issue to the story of Colonel William Boyce "Facts" Thompson, and the newly-organized Thompson Institute for Plant Research, which has been established in Yonkers, N. Y., for the purpose of getting the facts about plant life, plant growth, protection and development of plants. In this connection a description is given of a part of the greenhouses at the research laboratory which have been equipped with the Carrier Company's "manufactured weather."

## The Fan Pressure Blower as a Safety Factor in the Modern Gas Works.

Perhaps one of the greatest items causing serious breakdowns in the gas manufacturing plant for many years has been leakage of back pressure gas, either through the generator blast valve or the carburetor valve into the air ducts, but more particularly in the former. Undue friction in the sliding seats of the generator blast valve, against which high pressure is applied, often results in appreciable wear, and consequently a decided leakage occurs. Sufficient gas escapes into the air duct, as every gas manufacturer has experienced, to result in an ultimate perfect mixture, with what result is too well known to need repeating.

The trend of the times therefore, has been to use heavier metal ducts, about ¼ in. thickness being generally used, with heavier metal plates for the generators and superheaters, installation of a greater number of explosion heads, etc. But more important than all these factors, writes Arthur L. Greene of the Buffalo Forge Company, has been the greater use of fan pressure blowers, either electrically or steam turbine driven, to create a rapid, and high air pressure in the duct lines leading to the gas generators. While the amount of pressure is variable, depending on the particular installation, kind of fuel, size, moisture, etc., it comes well within range of the average gas plant to estimate pressure employed at 26 to 30 in. The old days of the limited pressure of 12 and 14 in. has gone the way of other discarded practices, and with increased pressure has developed the practical elimination of explosion in the duct system, through counter pressure exerted on the gas escaping through the valves when a leak occurs, and the practical elimination of any possibility of explosion in the superheater. Besides the safety factor, it has been demonstrated that the fan system pressure blower has a decided advantage over the older type of direct pressure through greater simplicity of parts, higher efficiency, less initial cost and less expense for upkeep.

Just as surely as gas and oil are spelling the end of King Coal as the heating unit of the future, so in a similar manner, it is felt, will the fan pressure blower dominate the field in the manufacture of gas as combining the essential factors of greatest efficiency, greatest economy and greatest safety in operation.

## Importance of Correct Balance in the Modern High-Speed Fan.

All who have had to do with fan work are aware of the occasional troubles experienced by fan manufacturers and the trade in general with fan wheels, supposedly balanced perfectly, which develop operating difficulties due to vibration. Although not always serious, it may become so and can only be removed by rebalancing the fan in position which, at the best, is a difficult task for one without special experience.

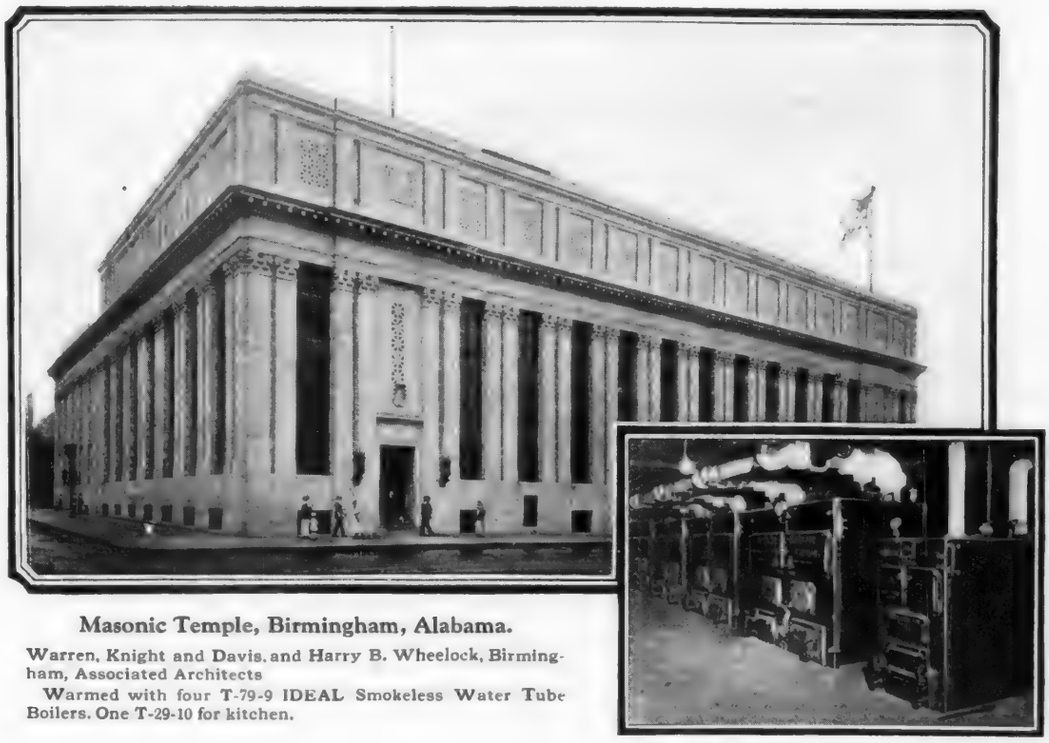
For this reason there is timeliness in an account given by Arthur L. Greene, of the Buffalo Forge Company, of the steps and methods used by that company to attain both static and dynamic balance in its high-speed fans. Static balance is the balancing of an object while in a stationary position by placement on a knife-edge or roller bearing support. If it shows no tendency to roll, the body is in static balance. Dynamic balancing is the adjusting of those forces which tend to take the body out of equilibrium when running.

When high-speed fans for motor and turbine drive came into use, it was found impracticable to perform the running balance in their own bearings, due largely to the fact that a great deal of power was required to run these outfits at full speed. To solve this problem the Buffalo Forge Company installed two dynamic balancing machines in which the object to be balanced is rotated at a comparatively slow speed while vibrating supports allow the rotating object, when out of balance, to indicate this unbalance by exaggerated vibrations. By means of adjustments made in both the angular position and radial displacement of a known weight which is attached to the shaft or mandrel and rotates with the object, a new centrifugal force is set up which exactly compensates for the force or forces tending to unbalance the rotating object, and brings the rotating object into a state of rotating equilibrium. By an adjustment of the balancing machine the whole machine may be made to vibrate to the rotation of a statically unbalanced object.

On the other hand another adjustment of thema the machine will cause only one of the two bearings supporting the rotor to vibrate and will thus indicate the dynamic unbalance of the rotating object. Static unbalance also can be detected very accurately by a balancing machine.

Having brought the object to a state of rotating equilibrium, either for static or dynamic unbalance, it is an easy matter to determine the amount and position of weights which will permanently compensate for either unbalanced condition. Static unbalance is always corrected first and this is a prerequisite to putting an object in correct dynamic balance. A simple logarithmic chart devised by the company allows the workman who operates the machine to calculate the permanent weight or weights required as quickly as he could caliper and measure the diameter of a shaft

# Two architects and three engineers agreed on this heating plant



**Masonic Temple, Birmingham, Alabama.**

Warren, Knight and Davis, and Harry B. Wheelock, Birmingham, Associated Architects

Warmed with four T-79-9 IDEAL Smokeless Water Tube Boilers. One T-29-10 for kitchen.

BIRMINGHAM'S beautiful Masonic Temple is warmed by a battery of four T-79-9 IDEAL Smokeless Tube Boilers.

Low pressure boilers for this handsome building were decided upon only after the most thorough consultation among the architects, Mr. H. B. Wheelock, and Warren, Knight and Davis of Birmingham, Mr. Ray S. Wilde, Consulting Engineer of Detroit, and the two engineers on the Building Committee.

The performance record of this battery of IDEAL 79″ Boilers has thoroughly vindicated the judgment of these architects and engineers. For Mr. F. B. Keiser, President of the Masonic Temple Association of Birmingham, writes: "We are pleased to advise that the boilers are satisfactory from a standpoint of fuel consumption, efficiency and splendid results derived from the individual units. One boiler carries the load in mild weather. We shall be glad to have you refer anyone to us for information."

If your files do not already carry complete information about the IDEAL 79″ Boiler, write to either address below for a catalogue.

## AMERICAN RADIATOR COMPANY

*IDEAL Boilers and AMERICAN Radiators for every heating need*

104 W. 42d Street, New York Dept. T 35 816 So. Michigan Avenue, Chicago

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

## RADIATOR RATINGS

**One-Column Steam, Exposed.**

STEAM AT 215° F.

# 1 COLUMN RADIATOR EXPOSED RATING

| SECTIONS | LENGTH IN INCHES | 38" | | 32" | | 26" | | 23" | | 20" | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot |
| 2 | 5 | 6 | 7.9 | 5 | 6.8 | 4 | 5.6 | 3⅓ | 4.8 | 3 | 4.3 |
| 3 | 7½ | 9 | 10.7 | 7½ | 9.3 | 6 | 7.6 | 5 | 6.5 | 4½ | 5.9 |
| 4 | 10 | 12 | 13.5 | 10 | 11.6 | 8 | 9.6 | 6⅔ | 8.2 | 6 | 7.4 |
| 5 | 12½ | 15 | 16.3 | 12½ | 14.1 | 10 | 11.6 | 8⅓ | 9.9 | 7½ | 9.0 |
| 6 | 15 | 18 | 19.2 | 15 | 16.6 | 12 | 13.7 | 10 | 10.6 | 9 | 10.5 |
| 7 | 17½ | 21 | 22.0 | 17½ | 19.1 | 14 | 15.7 | 11⅔ | 13.3 | 10½ | 12.2 |
| 8 | 20 | 24 | 24.9 | 20 | 21.6 | 16 | 17.7 | 13⅓ | 15.1 | 12 | 13.7 |
| 9 | 22½ | 27 | 27.8 | 22½ | 24.1 | 18 | 19.8 | 15 | 16.9 | 13½ | 15.4 |
| 10 | 25 | 30 | 30.7 | 25 | 26.6 | 20 | 21.8 | 16⅔ | 18.6 | 15 | 16.9 |
| 11 | 27½ | 33 | 33.5 | 27½ | 29.0 | 22 | 23.8 | 18⅓ | 20.3 | 16½ | 18.5 |
| 12 | 30 | 36 | 36.4 | 30 | 31.5 | 24 | 25.1 | 20 | 22.0 | 18 | 19.3 |
| 13 | 32½ | 39 | 39.3 | 32½ | 34.0 | 26 | 27.9 | 21⅔ | 23.8 | 19½ | 21.7 |
| 14 | 35 | 42 | 42.0 | 35 | 36.5 | 28 | 29.9 | 23⅓ | 25.5 | 21 | 23.2 |
| 15 | 37½ | 45 | 45.0 | 37½ | 39.0 | 30 | 32.0 | 25 | 27.3 | 22½ | 24.8 |
| 16 | 40 | 48 | 47.8 | 40 | 41.4 | 32 | 34.0 | 26⅔ | 29.0 | 24 | 26.4 |
| 17 | 42½ | 51 | 50.5 | 42½ | 43.9 | 34 | 36.0 | 28⅓ | 30.7 | 25½ | 28.3 |
| 18 | 45 | 54 | 53.3 | 45 | 46.2 | 36 | 38.1 | 30 | 32.4 | 27 | 30.3 |
| 19 | 47½ | 57 | 56.3 | 47½ | 48.8 | 38 | 40.2 | 31⅔ | 34.2 | 28½ | 31.1 |
| 20 | 50 | 60 | 59.0 | 50 | 51.2 | 40 | 42.2 | 33⅓ | 35.8 | 30 | 32.6 |
| 21 | 52½ | 63 | 61.7 | 52½ | 53.5 | 42 | 44.1 | 35 | 37.5 | 31½ | 34.2 |
| 22 | 55 | 66 | 64.6 | 55 | 56.1 | 44 | 46.6 | 36⅔ | 39.3 | 33 | 35.7 |
| 23 | 57½ | 69 | 67.3 | 57½ | 58.4 | 46 | 48.2 | 38⅓ | 40.9 | 34½ | 37.3 |
| 24 | 60 | 72 | 70.0 | 60 | 60.9 | 48 | 50.7 | 40 | 42.7 | 36 | 38.8 |
| 25 | 62½ | 75 | 72.9 | 62½ | 63.2 | 50 | 52.2 | 41⅔ | 44.3 | 37½ | 40.5 |
| 26 | 65 | 78 | 75.8 | 65 | 65.7 | 52 | 54.2 | 43⅓ | 45.7 | 39 | 42.1 |
| 27 | 67½ | 81 | 78.7 | 67½ | 68.3 | 54 | 56.3 | 45 | 47.8 | 40½ | 43.5 |
| 28 | 70 | 84 | 81.3 | 70 | 70.5 | 56 | 58.7 | 46⅔ | 49.4 | 42 | 45.1 |
| 29 | 72½ | 87 | 83.8 | 72½ | 72.8 | 58 | 60.0 | 48⅓ | 51.0 | 43½ | 46.6 |
| 30 | 75 | 90 | 86.7 | 75 | 75.3 | 60 | 62.0 | 50 | 52.8 | 45 | 48.0 |
| 31 | 77½ | 93 | 89.2 | 77½ | 77.5 | 62 | 63.9 | 51⅔ | 54.3 | 46½ | 49.4 |
| 32 | 80 | 96 | 92.1 | 80 | 80.1 | 64 | 66.0 | 53⅓ | 56.1 | 48 | 51.0 |
| 33 | 82½ | 99 | 94.6 | 82½ | 82.0 | 66 | 67.8 | 55 | 57.6 | 49½ | 52.5 |
| 34 | 85 | 102 | 97.5 | 85 | 84.6 | 68 | 69.9 | 56⅔ | 59.3 | 51 | 54.0 |
| 35 | 87½ | 105 | 99.9 | 87½ | 86.8 | 70 | 71.6 | 58⅓ | 60.9 | 52½ | 55.0 |
| 36 | 90 | 108 | 102.8 | 90 | 89.2 | 72 | 73.7 | 60 | 62.6 | 54 | 57.0 |
| 37 | 92½ | 111 | 105.2 | 92½ | 91.4 | 74 | 75.4 | 61⅔ | 64.1 | 55½ | 58.6 |
| 38 | 95 | 114 | 108.0 | 95 | 93.8 | 76 | 77.5 | 63⅓ | 65.8 | 57 | 59.9 |
| 39 | 97½ | 117 | 109.0 | 97½ | 94.8 | 78 | 79.2 | 65 | 67.3 | 58½ | 61.5 |
| 40 | 100 | 120 | 111.8 | 100 | 97.2 | 80 | 81.2 | 66⅔ | 69.0 | 60 | 63.1 |

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RADIATOR RATINGS—1-COL. STEAM, EXPOSED | No. 14

*Copies of this Data Sheet, printed separately, 5 cents each.*

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

## RADIATOR RATINGS

**Two-Column Steam, Exposed.**

STEAM AT 215°

# 2 COLUMN RADIATOR EXPOSED RATING

| SECTIONS | LENGTH IN INCHES | 45" | | 38" | | 32" | | 26" | | 23" | | 20" | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot | Actual Surface | Equivalent surface at 250 b.t.u. per square foot |
| 2 | 5 | 10 | 11.9 | 8 | 9.9 | 6⅔ | 8 | 5⅓ | 6.8 | 4⅗ | 6.2 | 4 | 5.3 |
| 3 | 7½ | 15 | 16.3 | 12 | 13.4 | 10 | 11.5 | 8 | 9.2 | 7 | 8.4 | 6 | 7.4 |
| 4 | 10 | 20 | 20.5 | 16 | 16.8 | 13⅓ | 14.4 | 10⅔ | 12.1 | 9⅘ | 10.6 | 8 | 9.3 |
| 5 | 12½ | 25 | 24.6 | 20 | 20.2 | 16⅔ | 17.6 | 13⅓ | 14.5 | 11⅔ | 13.9 | 10 | 11.2 |
| 6 | 15 | 30 | 29.5 | 24 | 24.0 | 20 | 20.6 | 16 | 17.2 | 14 | 15.2 | 12 | 13.2 |
| 7 | 17½ | 35 | 33.6 | 28 | 27.7 | 23⅓ | 23.7 | 18⅔ | 19.8 | 16⅓ | 17.4 | 14 | 15.2 |
| 8 | 20 | 40 | 38.0 | 32 | 31.2 | 26⅔ | 26.9 | 21⅓ | 22.2 | 18⅔ | 19.7 | 16 | 17.2 |
| 9 | 22½ | 45 | 42.4 | 36 | 34.7 | 30 | 30.0 | 24 | 24.6 | 21 | 22.0 | 18 | 19.2 |
| 10 | 25 | 50 | 46.8 | 40 | 38.4 | 33⅓ | 33.0 | 26⅔ | 27.3 | 23⅓ | 24.2 | 20 | 21.2 |
| 11 | 27½ | 55 | 51.1 | 44 | 41.9 | 36⅔ | 36.1 | 29⅓ | 29.6 | 25⅔ | 26.5 | 22 | 23.1 |
| 12 | 30 | 60 | 55.4 | 48 | 45.6 | 40 | 39.0 | 32 | 32.1 | 28 | 28.7 | 24 | 25.2 |
| 13 | 32½ | 65 | 59.9 | 52 | 49.1 | 43⅓ | 42.1 | 34⅔ | 34.5 | 30⅓ | 30.8 | 26 | 27.0 |
| 14 | 35 | 70 | 64.2 | 56 | 52.6 | 46⅔ | 45.2 | 37⅓ | 37.0 | 32⅔ | 33.1 | 28 | 29.0 |
| 15 | 37½ | 75 | 68.4 | 60 | 56.2 | 50 | 48.2 | 40 | 39.5 | 35 | 35.3 | 30 | 31.0 |
| 16 | 40 | 80 | 72.7 | 64 | 59.6 | 53⅓ | 51.2 | 42⅔ | 42.0 | 37⅓ | 37.5 | 32 | 33.0 |
| 17 | 42½ | 85 | 77.0 | 68 | 63.1 | 56⅔ | 54.2 | 45⅓ | 44.4 | 39⅔ | 39.7 | 34 | 34.8 |
| 18 | 45 | 90 | 81.3 | 72 | 66.9 | 60 | 57.4 | 48 | 47.1 | 42 | 42.0 | 36 | 36.8 |
| 19 | 47½ | 95 | 85.6 | 76 | 70.4 | 63 | 60.3 | 50⅔ | 49.3 | 44⅓ | 44.1 | 38 | 38.8 |
| 20 | 50 | 100 | 89.6 | 80 | 73.5 | 66⅔ | 63.2 | 53⅓ | 51.9 | 46⅔ | 46.4 | 40 | 40.6 |
| 21 | 52½ | 105 | 94.1 | 84 | 77.2 | 70 | 66.4 | 56 | 54.3 | 49 | 48.6 | 42 | 42.7 |
| 22 | 55 | 110 | 98.2 | 88 | 80.6 | 73⅓ | 69.2 | 58⅔ | 56.9 | 51⅓ | 50.9 | 44 | 44.5 |
| 23 | 57½ | 115 | 102.8 | 92 | 84.2 | 76⅔ | 72.5 | 61⅓ | 59.4 | 53⅔ | 53.0 | 46 | 46.5 |
| 24 | 60 | 120 | 106.7 | 96 | 87.5 | 80 | 75.3 | 64 | 61.8 | 56 | 55.1 | 48 | 48.4 |
| 25 | 62½ | 125 | 111.0 | 100 | 91.3 | 83⅓ | 78.3 | 66⅔ | 64.2 | 58⅓ | 57.3 | 50 | 50.4 |
| 26 | 65 | 130 | 115.0 | 104 | 94.5 | 86⅔ | 81.0 | 69⅓ | 67.0 | 60⅔ | 60.2 | 52 | 52.4 |
| 27 | 67½ | 135 | 119.0 | 108 | 98.0 | 90 | 84.3 | 72 | 69.0 | 63 | 61.9 | 54 | 54.2 |
| 28 | 70 | 140 | 123.1 | 112 | 101.1 | 93⅓ | 86.9 | 74⅔ | 71.8 | 65⅓ | 63.9 | 56 | 56.2 |
| 29 | 72½ | 145 | 127.6 | 116 | 104.9 | 96⅔ | 90.3 | 77⅓ | 74.0 | 67⅔ | 66.0 | 58 | 58.0 |
| 30 | 75 | 150 | 131.6 | 120 | 108.0 | 100 | 92.8 | 80 | 76.2 | 70 | 68.1 | 60 | 59.9 |
| 31 | 77½ | 155 | 135.6 | 124 | 111.1 | 103⅓ | 95.9 | 82⅔ | 78.2 | 72⅓ | 70.0 | 62 | 61.4 |
| 32 | 80 | 160 | 139.0 | 128 | 114.7 | 106⅔ | 98.5 | 85⅓ | 81.0 | 74⅔ | 72.2 | 64 | 63.3 |
| 33 | 82½ | 165 | 143.2 | 132 | 117.8 | 110 | 101.1 | 88 | 83.1 | 77 | 74.2 | 66 | 65.2 |
| 34 | 85 | 170 | 147.5 | 136 | 121.2 | 113⅓ | 104.3 | 90⅔ | 85.3 | 79⅓ | 76.4 | 68 | 67.2 |
| 35 | 87½ | 175 | 151.2 | 140 | 124.2 | 116⅓ | 107.0 | 93⅓ | 87.8 | 81⅔ | 78.3 | 70 | 68.9 |
| 36 | 90 | 180 | 155.7 | 144 | 127.9 | 120 | 110.0 | 96 | 90.2 | 84 | 80.6 | 72 | 70.8 |
| 37 | 92½ | 185 | 159.9 | 148 | 131.2 | 123⅓ | 113.0 | 98⅔ | 92.8 | 86⅓ | 82.9 | 74 | 72.8 |
| 38 | 95 | 190 | 163.3 | 152 | 134.2 | 126⅔ | 115.5 | 101⅓ | 95.2 | 88⅔ | 84.9 | 76 | 74.6 |
| 39 | 97½ | 195 | 167.8 | 156 | 138.0 | 130 | 118.6 | 104 | 97.4 | 91 | 87.0 | 78 | 76.4 |
| 40 | 100 | 200 | 172.0 | 160 | 141.6 | 133⅓ | 121.6 | 106⅔ | 100.0 | 93⅓ | 89.2 | 80 | 78.2 |

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RADIATOR RATINGS—2-COL. STEAM, EXPOSED | No. 14-A

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

## RADIATOR RATINGS

### Three-Column Steam, Exposed

STEAM AT 215° F.

# 3 COLUMN RADIATOR EXPOSED RATING

| SECTIONS | LENGTH IN INCHES | 45" | | 38" | | 32" | | 26" | | 22" | | 18" | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Actual Surface | Equivalent surface at 250 btu. per square foot | Actual Surface | Equivalent surface at 250 btu. per square foot | Actual Surface | Equivalent surface at 250 btu. per square foot | Actual Surface | Equivalent surface at 250 btu. per square foot | Actual Surface | Equivalent surface at 250 btu. per square foot | Actual Surface | Equivalent surface at 250 btu. per square foot |
| 2 | 5 | 12 | 13.3 | 10 | 11.4 | 9 | 10.7 | 7½ | 9.2 | 6 | 7.6 | 4½ | 5.7 |
| 3 | 7½ | 18 | 18.1 | 15 | 15.6 | 13½ | 14.6 | 11¼ | 12.5 | 9 | 10.3 | 6¾ | 7.7 |
| 4 | 10 | 24 | 22.8 | 20 | 19.6 | 18 | 21.6 | 15 | 15.8 | 12 | 13.0 | 9 | 10.1 |
| 5 | 12½ | 30 | 27.6 | 25 | 23.7 | 22½ | 22.1 | 18¾ | 19.1 | 15 | 15.8 | 11¼ | 12.2 |
| 6 | 15 | 36 | 32.4 | 30 | 28.2 | 27 | 25.9 | 22½ | 27.5 | 18 | 18.5 | 13½ | 14.5 |
| 7 | 17½ | 42 | 37.3 | 35 | 32.2 | 31½ | 29.9 | 26¼ | 25.7 | 21 | 21.4 | 15¾ | 16.5 |
| 8 | 20 | 48 | 42.2 | 40 | 36.8 | 36 | 33.8 | 30 | 29.4 | 24 | 24.0 | 18 | 18.7 |
| 9 | 22½ | 54 | 47.5 | 45 | 40.9 | 40½ | 38.1 | 33¾ | 32.4 | 27 | 27.0 | 20¼ | 20.7 |
| 10 | 25 | 60 | 52.2 | 50 | 45.0 | 45 | 41.8 | 37½ | 36.0 | 30 | 29.7 | 22½ | 22.9 |
| 11 | 27½ | 66 | 56.7 | 55 | 49.5 | 49½ | 45.5 | 41¼ | 39.2 | 33 | 32.3 | 24¾ | 24.9 |
| 12 | 30 | 72 | 61.9 | 60 | 53.6 | 54 | 49.6 | 45 | 42.7 | 36 | 35.3 | 27 | 27.1 |
| 13 | 32½ | 78 | 67.1 | 65 | 57.8 | 58½ | 53.7 | 48¾ | 45.8 | 39 | 37.4 | 29¼ | 29.3 |
| 14 | 35 | 84 | 72.2 | 70 | 62.3 | 63 | 57.3 | 52½ | 49.4 | 42 | 40.7 | 31½ | 31.5 |
| 15 | 37½ | 90 | 76.5 | 75 | 66.0 | 67½ | 61.4 | 56¼ | 52.9 | 45 | 43.7 | 33¾ | 33.5 |
| 16 | 40 | 96 | 81.6 | 80 | 70.4 | 72 | 65.5 | 60 | 56.4 | 48 | 46.1 | 36 | 35.7 |
| 17 | 42½ | 102 | 86.7 | 85 | 74.9 | 76½ | 69.6 | 63¾ | 59.9 | 51 | 49.0 | 38¼ | 37.9 |
| 18 | 45 | 108 | 90.7 | 90 | 79.2 | 81 | 72.7 | 67½ | 62.8 | 54 | 51.8 | 40½ | 40.0 |
| 19 | 47½ | 114 | 95.8 | 95 | 82.6 | 85½ | 77.0 | 71¼ | 66.3 | 57 | 54.7 | 42¾ | 42.0 |
| 20 | 50 | 120 | 100.1 | 100 | 87.0 | 90 | 81.0 | 75 | 69.8 | 60 | 57.6 | 45 | 44.4 |
| 21 | 52½ | 126 | 105.8 | 105 | 91.3 | 94½ | 84.1 | 78¾ | 72.5 | 63 | 59.9 | 47¼ | 46.4 |
| 22 | 55 | 132 | 110.8 | 110 | 95.7 | 99 | 88.1 | 82½ | 75.9 | 66 | 63.1 | 49½ | 48.5 |
| 23 | 57½ | 138 | 115.9 | 115 | 100.1 | 103½ | 92.1 | 86¼ | 79.4 | 69 | 66.1 | 51¾ | 50.7 |
| 24 | 60 | 144 | 119.6 | 120 | 103.2 | 108 | 96.1 | 90 | 82.8 | 72 | 68.4 | 54 | 52.8 |
| 25 | 62½ | 150 | 124.5 | 125 | 107.5 | 112½ | 100.1 | 93¾ | 86.3 | 75 | 71.3 | 56¼ | 54.1 |
| 26 | 65 | 156 | 129.4 | 130 | 111.8 | 117 | 104.1 | 97½ | 89.3 | 78 | 74.1 | 58½ | 57.3 |
| 27 | 67½ | 162 | 134.4 | 135 | 116.1 | 121½ | 106.9 | 101¼ | 92.2 | 81 | 76.1 | 60¾ | 59.0 |
| 28 | 70 | 168 | 137.7 | 140 | 120.4 | 126 | 110.3 | 105 | 95.5 | 84 | 79.0 | 63 | 61.0 |
| 29 | 72½ | 174 | 142.6 | 145 | 124.7 | 130½ | 114.9 | 108¾ | 99.0 | 87 | 81.8 | 65¼ | 64.2 |
| 30 | 75 | 180 | 147.6 | 150 | 127.5 | 135 | 118.8 | 112½ | 102.3 | 90 | 86.6 | 67½ | 65.1 |
| 31 | 77½ | 186 | 151.5 | 155 | 131.7 | 139½ | 122.8 | 116¼ | 105.8 | 93 | 87.4 | 69¾ | 67.0 |
| 32 | 80 | 192 | 157.4 | 160 | 136.0 | 144 | 126.7 | 120 | 109.2 | 96 | 90.2 | 72 | 69.0 |
| 33 | 82½ | 198 | 162.3 | 165 | 140.2 | 148½ | 129.2 | 123¾ | 112.6 | 99 | 92.1 | 74¼ | 71.3 |
| 34 | 85 | 204 | 167.2 | 170 | 144.5 | 153 | 133.1 | 127½ | 116.0 | 102 | 94.9 | 76½ | 73.3 |
| 35 | 87½ | 210 | 170.1 | 175 | 147.0 | 157½ | 137.2 | 131¼ | 118.9 | 105 | 97.7 | 78¾ | 75.1 |
| 36 | 90 | 216 | 174.9 | 180 | 151.2 | 162 | 141.0 | 135 | 123.0 | 108 | 100.4 | 81 | 77.7 |
| 37 | 92½ | 222 | 179.8 | 185 | 155.4 | 166½ | 144.5 | 138¾ | 125.1 | 111 | 103.2 | 83¼ | 79.9 |
| 38 | 95 | 228 | 184.6 | 190 | 159.6 | 171 | 148.3 | 142½ | 128.0 | 114 | 105.8 | 85½ | 81.5 |
| 39 | 97½ | 234 | 189.5 | 195 | 163.8 | 175½ | 153.9 | 146¼ | 131.1 | 117 | 107.8 | 87¾ | 83.3 |
| 40 | 100 | 240 | 195.0 | 200 | 168.0 | 180 | 155.6 | 150 | 134.0 | 120 | 110.4 | 90 | 85.8 |

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RADIATOR RATINGS—3-COL. STEAM, EXPOSED | No. 14-B

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

## RADIATOR RATINGS

### Four-Column Steam, Exposed

STEAM AT 215° F.

# 4 COLUMN RADIATOR EXPOSED RATING

| SECTIONS | LENGTH IN INCHES | 45" | | 38" | | 32" | | 26" | | 22" | | 18" | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Actual Surface | Equivalent surface at 250 btu per square foot | Actual Surface | Equivalent surface at 250 btu per square foot | Actual Surface | Equivalent surface at 250 btu per square foot | Actual Surface | Equivalent surface at 250 btu per square foot | Actual Surface | Equivalent surface at 250 btu per square foot | Actual Surface | Equivalent surface at 250 btu per square foot |
| 2 | 6 | 20 | 21.0 | 16 | 17.2 | 13 | 14.5 | 10 | 11.4 | 8 | 9.5 | 6 | 7.3 |
| 3 | 9 | 30 | 28.6 | 24 | 23.3 | 19½ | 19.6 | 15 | 15.6 | 12 | 12.9 | 9 | 9.9 |
| 4 | 12 | 40 | 36.0 | 32 | 29.4 | 26 | 24.8 | 20 | 19.7 | 16 | 16.3 | 12 | 12.5 |
| 5 | 15 | 50 | 43.5 | 40 | 35.5 | 32½ | 29.9 | 25 | 23.8 | 20 | 19.7 | 15 | 15.1 |
| 6 | 18 | 60 | 51.2 | 48 | 42.2 | 39 | 35.2 | 30 | 28.1 | 24 | 23.1 | 18 | 17.8 |
| 7 | 21 | 70 | 58.1 | 56 | 48.3 | 45½ | 40.6 | 35 | 32.3 | 28 | 26.8 | 21 | 20.5 |
| 8 | 24 | 80 | 66.9 | 64 | 54.8 | 52 | 45.9 | 40 | 36.7 | 32 | 30.2 | 24 | 23.2 |
| 9 | 27 | 90 | 74.6 | 72 | 61.0 | 58½ | 51.3 | 45 | 40.8 | 36 | 33.7 | 27 | 25.9 |
| 10 | 30 | 100 | 82.0 | 80 | 67.3 | 65 | 56.3 | 50 | 44.9 | 40 | 37.0 | 30 | 28.6 |
| 11 | 33 | 110 | 88.9 | 88 | 73.8 | 71½ | 61.7 | 55 | 49.4 | 44 | 40.5 | 33 | 31.3 |
| 12 | 36 | 120 | 97.4 | 96 | 80.2 | 78 | 67.0 | 60 | 53.6 | 48 | 44.0 | 36 | 34.0 |
| 13 | 39 | 130 | 104.9 | 104 | 85.9 | 84½ | 72.3 | 65 | 57.6 | 52 | 47.5 | 39 | 36.7 |
| 14 | 42 | 140 | 113.2 | 112 | 92.6 | 91 | 78.0 | 70 | 62.0 | 56 | 51.0 | 42 | 39.5 |
| 15 | 45 | 150 | 120.5 | 120 | 98.7 | 97½ | 83.0 | 75 | 66.2 | 60 | 54.4 | 45 | 42.2 |
| 16 | 48 | 160 | 128.0 | 128 | 105.0 | 104 | 88.2 | 80 | 70.5 | 64 | 57.7 | 48 | 44.7 |
| 17 | 51 | 170 | 136.0 | 136 | 111.3 | 110½ | 93.7 | 85 | 74.7 | 68 | 61.3 | 51 | 47.6 |
| 18 | 54 | 180 | 143.2 | 144 | 117.5 | 117 | 98.6 | 90 | 79.0 | 72 | 64.8 | 54 | 50.0 |
| 19 | 57 | 190 | 150.6 | 152 | 123.3 | 123½ | 103.5 | 95 | 83.0 | 76 | 68.2 | 57 | 52.5 |
| 20 | 60 | 20 | 158.5 | 160 | 130.3 | 130 | 109.2 | 100 | 87.2 | 80 | 71.7 | 60 | 55.2 |
| 21 | 63 | 210 | 165.2 | 168 | 135.4 | 136½ | 114.3 | 105 | 91.0 | 84 | 75.2 | 63 | 58.0 |
| 22 | 66 | 220 | 173.4 | 176 | 142.1 | 143 | 119.8 | 110 | 95.2 | 88 | 78.7 | 66 | 60.7 |
| 23 | 69 | 230 | 181.1 | 184 | 148.7 | 149½ | 125.2 | 115 | 99.8 | 92 | 82.2 | 69 | 63.4 |
| 24 | 72 | 240 | 188.1 | 192 | 154.2 | 156 | 130.0 | 120 | 103.5 | 96 | 84.9 | 72 | 66.1 |
| 25 | 75 | 250 | 191.2 | 200 | 160.7 | 162½ | 135.2 | 125 | 107.6 | 100 | 88.7 | 75 | 68.9 |
| 26 | 78 | 260 | 203.0 | 208 | 167.3 | 169 | 141.0 | 130 | 112.0 | 104 | 97.3 | 78 | 71.5 |
| 27 | 81 | 270 | 210.5 | 216 | 172.4 | 175½ | 145.3 | 135 | 116.2 | 108 | 95.1 | 81 | 74.0 |
| 28 | 84 | 280 | 217.3 | 224 | 179.0 | 182 | 150.0 | 140 | 120.0 | 112 | 98.5 | 84 | 76.1 |
| 29 | 87 | 290 | 225.0 | 232 | 184.3 | 188½ | 154.8 | 145 | 124.2 | 116 | 102.0 | 87 | 78.9 |
| 30 | 90 | 300 | 231.8 | 240 | 190.0 | 195 | 159.9 | 150 | 128.0 | 120 | 105.3 | 90 | 81.2 |
| 31 | 93 | 310 | 239.3 | 248 | 196.7 | 201½ | 164.7 | 155 | 134.0 | 124 | 108.6 | 93 | 83.9 |
| 32 | 96 | 320 | 247.0 | 256 | 202.8 | 208 | 171.0 | 160 | 136.5 | 128 | 112.5 | 96 | 86.5 |
| 33 | 99 | 330 | 253.3 | 264 | 208.0 | 214½ | 175.5 | 165 | 140.0 | 132 | 115.1 | 99 | 89.0 |
| 34 | 102 | 340 | 260.0 | 272 | 214.5 | 221 | 180.0 | 170 | 144.0 | 136 | 118.6 | 102 | 91.7 |
| 35 | 105 | 350 | 267.0 | 280 | 219.5 | 227½ | 185.0 | 175 | 147.2 | 140 | 121.2 | 105 | 94.2 |
| 36 | 108 | 360 | 275.0 | 288 | 227.9 | 234 | 191.0 | 180 | 151.2 | 144 | 124.7 | 108 | 97.0 |
| 37 | 111 | 370 | 283.0 | 296 | 232.0 | 240½ | 195.5 | 185 | 156.0 | 148 | 127.5 | 111 | 99.3 |
| 38 | 114 | 380 | 289.0 | 304 | 237.0 | 247 | 199.0 | 190 | 159.2 | 152 | 130.7 | 114 | 101.1 |
| 39 | 117 | 390 | 296.0 | 312 | 243.8 | 253½ | 204.8 | 195 | 163.5 | 156 | 134.0 | 117 | 104.0 |
| 40 | 120 | 400 | 302.5 | 320 | 248.2 | 260 | 209.2 | 200 | 168.0 | 160 | 137.5 | 120 | 106.5 |

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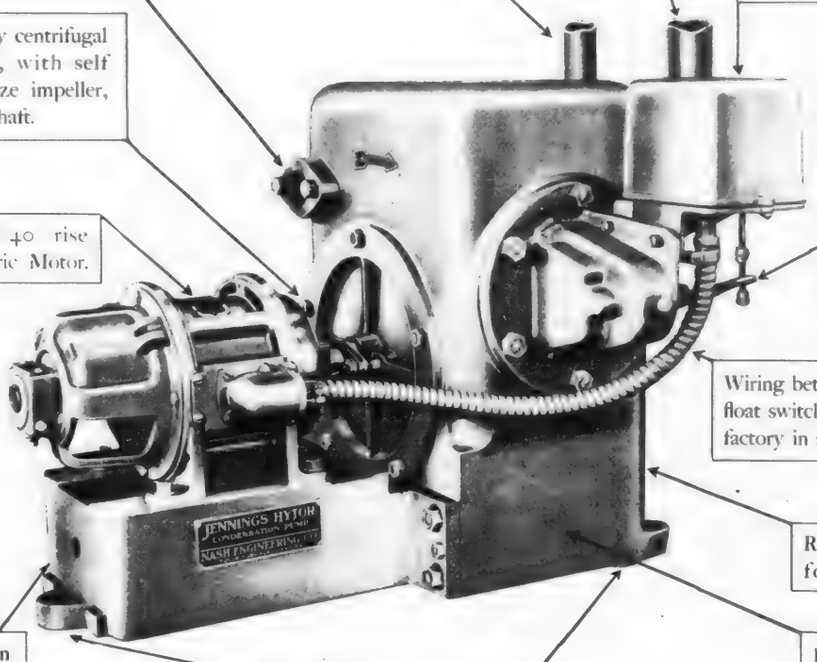
RADIATOR RATINGS—4-COL. STEAM, EXPOSED | No. 14C

*Copies of this Data Sheet, printed separately, 5 cents each.*

# THE NEW UNIT TYPE JENNINGS HYTOR CONDENSATION PUMPS


Boiler feed connection. Companion flanges supplied.
Air vent to atmosphere.
Gravity returns. Companion flanges supplied.
Totally enclosed double pole float switch with silver contacts.
Float mechanism can be removed as a unit.
High efficiency centrifugal water pump, with self cleaning bronze impeller, and bronze shaft.
Semi enclosed 40 rise General Electric Motor.
Float switch is positively operated by 5in. spun copper ball float on 10in. stem. Ball is tested to 100lbs.
Wiring between motor and float switch made up at the factory in armored conduit.
Receiving tank for returns.
Large settling chamber.
Deep drip pan with drain connection under both pump and motor.
3 point suspension of rigid base and tank preventing misalignment.
JENNINGS HYTOR
CONDENSATION PUMP
NASH ENGINEERING CO.

The illustration shows construction of the Jennings Condensation Pump Unit. By making the pump casing a part of the receiving tank and bolting to the tank the base supporting the motor, allowing the motor bearings to support the bronze impeller, great structural strength is secured. The three point support prevents the pump from being sprung out of line.

Large motor bearings supplied with ample oil wells support the pump impeller and keep it in alignment. Only occasional lubrication is necessary. The impeller is open type, self-cleaning, and very efficient.

The float switch mechanism is liberally proportioned, equipped with bronze shaft supported by two bearings.

The special G. E. double-pole float switch is totally enclosed and provided with silver contacts for long life. Switch mechanism can be removed as a unit.

The finest materials and best workmanship used in construction throughout, and all parts are machined to such close limits that absolute interchangeability is secured.

*For Detailed Description Ask for Bulletin No. 29*

**NASH ENGINEERING CO.**

**SO. NORWALK CONN., U. S. .A**

NASH ENGINEERING CO., South Norwalk, Conn., U. S. A.
Please send graphic device also bulletins covering
[ ] Hytor Air Compressors [ ] Return Line Heating Pumps
[ ] Hytor Vacuum Pumps [ ] Condensation Pumps
Name.....
Company.....
Position.....
Jan.

# Trade and Miscellaneous Notes

### Miscellaneous Notes

**National District Heating Association** will hold its next convention at the Hotel Commodore in New York City, June 10, 11 and 12, 1924. An announcement by President F. B. Orr of Chicago says that a wonderful amount of data has been collected and that the program will include papers and addresses of international importance.

**National Industrial Conference Board** announces the early operation of a nation-wide plan to reduce the number of accidents in American industries through establishment of 38 safety codes. Eight of the codes already have been completed. Experts believe workers will be protected to the fullest possible degree by standardization of factory practices.

**American Gas Association** estimates that sales of manufactured gas in 1923 by public utility companies amounted to between 365 and 375 billion cubic feet, a new high record for gas consumption and approximately 20 billion cubic feet over 1922 The association states that gas utilities spent $450,000,000 in a building and expansion program last year in an effort to keep up with present and accumulated demands for service, and that it is probable that sum will be increased materially in 1924.

**Coal Analyses** help to describe the character of the coal as it lies in the ground or as it may be delivered to the user, but it should be understood that there is a distinct difference between mine samples and delivered samples, N. H. Snyder, fuel engineer, points out in Technical Paper 344, recently issued by the U. S. Bureau of Mines.

**Investigations of the Relation of temperature to accidents,** made by H. M. Vernon, M. D., according to the *Journal of Industrial Hygiene,* disclosed that accidents were at a minimum at 67° F. and that they increased rapidly at lower and at higher temperatures. Thus, he found, accidents were 35% more numerous at 52° and 23% more numerous at 77° than they were at 67° F.

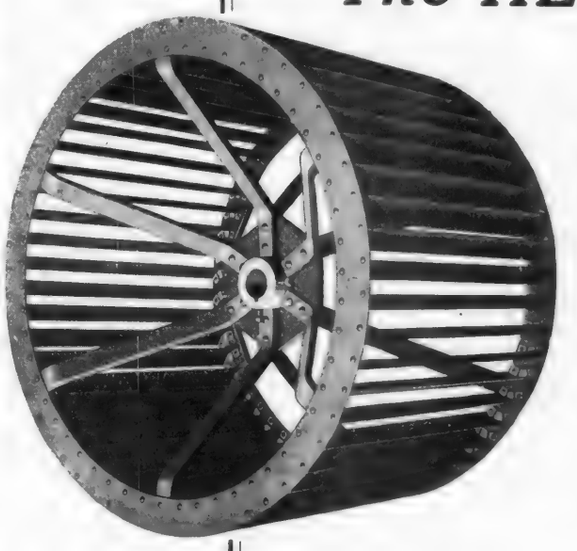
**Central Supply Association** will hold its winter meeting at the Drake Hotel in Chicago, Ill., February 20 and 21, 1924. A feature of the program will be an address on "Trade Associations and the Law" by Franklin D. Jones, Washington, D. C.

**Detroit Engineering Society** has issued an attractive booklet in celebration of the establishment of a home of its own. The society recently purchased a house near downtown Detroit which has been fitted up as a club home. First steps looking to the establishment of a home of its own were taken by the Society in 1922 when J. R. McColl, a past president of the American Society of Heating and Ventilating Engineers was its president. L. E. Williams is the present head of the society which has about 500 members and expects to add another 100 during 1924.

**Washington, D. C.**—Inventive genius has stimulated industrial production to a marked degree by making possible enlarged personal production, Julius H. Barnes, president of the Chamber of Commerce of the United States, pointed out recently in an address before the annual meetings of the American Economic Association and the American Statistical Association. Among the typical inventions contributed to increased production, Mr. Barnes cited the use of the skip hoist, larry car and automatic weigher in furnace charging. That invention, he said, permitted two men to do the work of fourteen.

**Industrial Standardization** continued to develop during 1923 as one of the most active and important phases of American Industry, A. W. Whitney, chairman of the American Engineering Standards Committee, has announced. Progress is noted by Mr


## *The HEART of a BLOWER*



The efficiency of a blower depends upon the design and construction of the wheel. Uniblade blower wheels are a strict departure from the customary types. Exceptionally quiet in operation, they are especially suited to installations in public buildings requiring the handling of large volumes of air at low pressures.

The channel iron spokes are securely riveted to the hub and also to the retaining rings, which are cut from one continuous piece of metal. Being riveted throughout, this wheel will operate quietly at high speeds and will not rack under strain or pressure.

A full explanation of Uniblade blower wheels is given in bulletin 58, along with other interesting data. Send for it.

REGISTERED AUTOVENT.

**AUTOVENT FAN & BLOWER CO.**

**DEPT. "H"**

**730-738 W. MONROE ST. - - CHICAGO**

Whitney in the standardization of raw materials, manufacturing processes and finished products. A striking development, he said, is the increased systematic use of specifications in public purchases, notably by the federal and several of the State governments. A dictionary of specifications for public purposes is being prepared by the U. S. Department of Commerce under the direction of Secretary Hoover, he said.

**Eastern Division of the Chamber of Commerce** met January 17 and 18 in Philadelphia, the meeting being the first to be held under the decentralization plan recently adopted. Similar regional meetings will be held in Chicago, New Orleans and San Francisco. Taxation, transportation immigration and the merchant marine were among the important subjects discussed.

**Engineering Section of the National Safety Council** and the American Society of Safety Engineers held a joint meeting in New York City January 22, the program featuring the subjects of handling material and gas and electric welding. Peter Spence, chief of the New York Fire Prevention Bureau, was on the program for a paper on "The Hazard of Fuel-Oil for Domestic Heating Purposes."

**Helping the Exporter** is the title of a booklet recently issued by the United States Department of Commerce. The book contains reprints of correspondence carried on between a manufacturer, who contemplated a sales campaign in South America, and the Department of Commerce. It offers a comprehensive service story for the novice in exporting.

**The Employes Magazine—Its Duties and Opportunities**, is the title of a 12-page pamphlet recently issued by the National Safety Council, Chicago, Ill.

**Chicago, Ill.**—Chicago oil-burning manufacturers and distributors met in the ball room of Hotel Virginia, Chicago, Ill., recently for the purpose of organizing a Chicago Oil Burner Club.

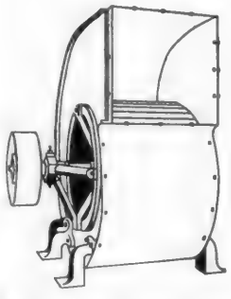
**Westfield, Mass.**—The H. B. Smith Co., Westfield, Mass., has announced plans for the construction of a $14,000 power and heating building at its North Side plant on North Elm St.

### Manufacturers' Notes

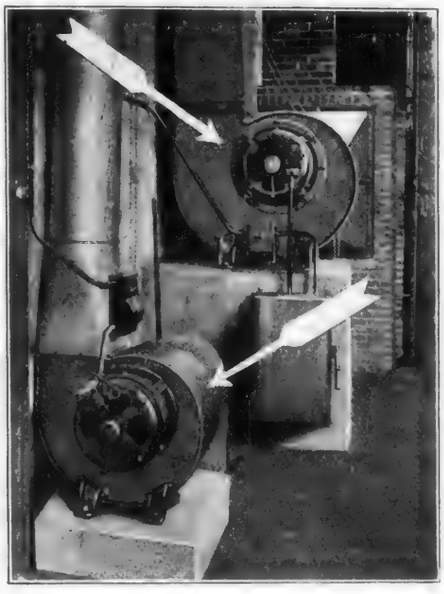
**Warren Webster & Co.**, Camden, N. J., manufacturers of steam heating sys-

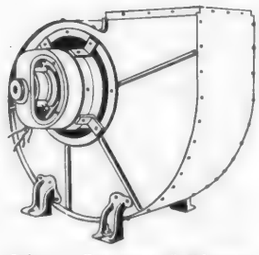

# ILG

**Universal Blowers are compact and interchangeable. They require no special pedestal for motor. There are no bearings in the suction inlet. All oiling is done on the motor or pulley side. These and other exclusive features are shown in a complete catalog. Send for it.**



*Belt Driven Type. Note Absence of Pedestal for Pulley.*





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# JOHNS-MANVILLE

tems and steam specialties, announce the appointment of Harold F. Marshall as advertising manager. Mr. Marshall was formerly advertising manager for Dwight P. Robinson & Co., Inc., New York.

**H. Mueller Mfg. Co.**, Decatur, Ill., has inaugurated an investment plan to encourage saving by its employees. Employees are invited, under the plan, to deposit weekly sums ranging from 50 cents to $5.00 with the company. At the end of the year the investor is given a check for the amount saved, plus 7% interest on the average in the account for the year. The plan is under the direction of the personal manager.

**Day and Night Water Heater Co.**, Monrovia, Calif., has just closed the most successful year of its history, President W. J. Bailey has announced. The company was formed 12 years ago. It manufactures three types of gas water heaters and the Day and Night Solar heater which uses the sun's rays to heat water.

**H. Mueller Mfg. Co.**, Decatur, Ill., has dedicated its new recreation hall, recently completed, and turned the management over to an executive committee composed of employees. The building is of brick, iron and concrete construction, 100 ft. x 60 ft. The basement contains a cafeteria where meals will be served to employees at cost. On the ground floor is a dining room for firm members and department heads. A well-equipped gymnasium offers recreational possibilities, while the size of the building is adequate for all the company's employees, assembled for business or social reasons.

**American Steam Pump Co.**, Battle Creek, Mich., has purchased the plant, assets and entire business of the Advance Pump & Compressor Co., also of Battle Creek. At the same time the company announces an increase in its capitalization from $500,000 to $1,000,000. Of the new stock present shareholders were given a 68% stock dividend and the balance used for the purchase of the Advance property. The American Steam Pump Co., under various names, has been in business as a corporation for 50 years, commencing the manufacture of the Marsh pump in 1888. Acquisition of the new property adds a line of duplex pumps to its former line of simplex and centrifugal pumps. Pumps heretofore known as "Advance" hereafter will be called the "American-Marsh."

**Youngstown Sheet & Tube Co.**, Youngstown, O., announces that it will forward one of its 1924 calendars to any reader of this magazine who cares to send five cents in stamps to cover the cost of mailing.

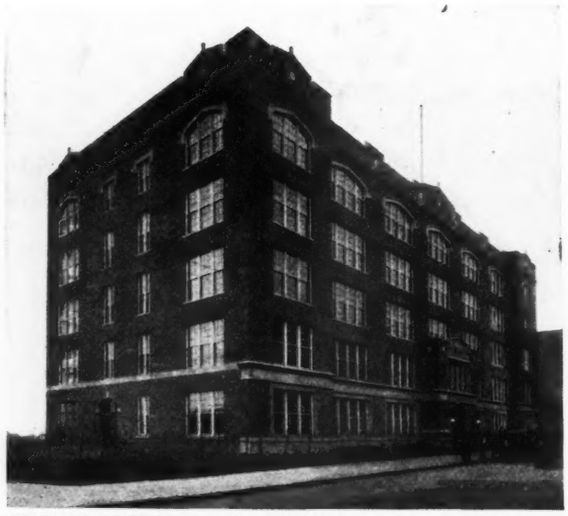
**Abram Cox Stove Co.**, Philadelphia, acted as host to about 75 members of its eastern and western sales representatives at the annual convention in Philadelphia recently. A dinner at Hotel Sylvania was the concluding feature of the three day meeting. E. F. Glore, general sales manager and secretary and treasurer of the company presided. Other speakers at the dinner included: Abram Cox Mott, president; George G. Fischer, manager of the western department; L. H. Steel, New York manager; E. C. Nigg, general superintendent and John W. Jones, assistant sales manager.

**Trane Co.**, La Cross, Wis., left to a vote of its employees whether they would receive 1% of their 1923 pay in cash or accept life insurance ranging from $500 to $1,000, according to length of service. A majority voted in favor of the cash bonus, which accordingly, was given them at Christmas time.

**Excelso Specialty Works, Inc.**, Buffalo, N. Y., served a turkey dinner to its employees at the company offices during the holidays. President C. P. Wadley recounted the company's history, while bonus checks were distributed to the employees.

**Atmospheric Conditioning Co.**, Philadelphia, held its annual sales convention at the home office recently. The western sales organization was represented by S. C. Bloom, vice president and general western manager, and T. T. Cash, branch manager at Minneapolis, Minn.

**Pierce, Butler & Pierce Mfg. Corporation**, New York, has named M. R. Bush, formerly manager of the company's branches in Detroit, Mich., Brooklyn, N. Y., and the Bronx in New York, as assistant to the purchasing agent of the company, with headquarters in New York. The company announces also the appointment of H. A. Butterfield, formerly manager of the Savannah Supply Co., Savannah, Ga., as manager of the Bronx office.

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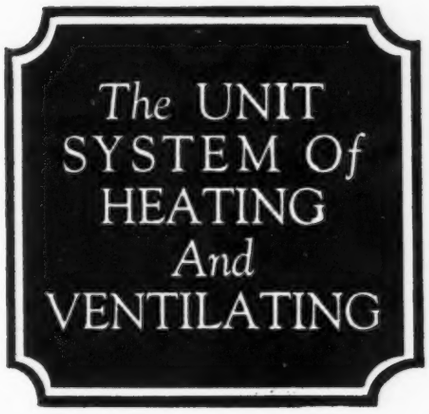


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708-10 Columbia Bank Bldg., Pittsburgh, Pa.
333 Jackson Building, Buffalo, N. Y.

**A. Z. Price Co., Charlotte, N. C.,** has appointed David H. Cuyler, for several years manager of the heating department of the Charlotte branch of Haines, Jones & Cadbury Co., Philadelphia, as engineer in charge of its design and estimating departments.

**American Radiator Co.,** New York, announces the election of Charles M. Parker as president of the company and the election of President Clarence M. Woolley as chairman of the company's board of directors. In a statement issued by Mr. Woolley, it is stated that the office of chairman of the board of directors was created at Mr. Woolley's request. "Larger opportunities," he adds, "for company development at home and abroad have presented themselves for alignment with established policies, and to this task I shall be enabled to direct my more definite energy. Release from some of the exactions imposed by the rapid growth of our business in America and Europe is no wise implies a less personal contact with the general supervision and conduct of the company's affairs. Mr. Parker, by long official association with the development of the American Radiator Company in all of its phases, is eminently qualified for the duties he has assumed." The statement concludes with the announcement that C. K. Foster, vice-president of the company, will have charge of the western executive offices in Chicago.

**Hoffman Specialty Co.,** New York, announces a revised price-list and trade discount sheet effective February 1 and superseding all previous lists. The company has recently opened a warehouse in Los Angeles, Cal., at 747 Warehouse street, where a complete stock of Hoffman products will be carried for the accommodation of the trade on the Pacific coast. Announcement is also made of the appointment of A. W. Cox as sales representative in the eastern half of New York State and of J. S. Bowers as sales representative in the St. Louis district.

George D. Hoffman, president of the Hoffman Specialty Co., is working on some laboratory experiments at his winter home in Pasadena, Calif., where he will remain until spring.

## Central Station Heating Notes

**Eugene, Ore.**—Twenty-eight buildings on the University campus are now being supplied with heat from the university central heating plant. The new power plant building has been completed at a cost of approximately $90,000.

**Corvallis, Ore.**—The new central heating plant at Oregon Agricultural college, which cost $126,000, has been completed and put into operation. Previously the college buildings were heated by separate heaters. A big saving is anticipated by college authorities through operation of the central system.

**Walla Walla, Wash.**—A central heating plant is being constructed in connection with the building of six cottages by B. M. Huntington and C. R. Baker of Walla Walla. An oil-burning steam heater will be installed in the central station.

**Mattoon, Ill.**—Plans are under way for the establishment of a central heating plant to furnish heat for all the buildings of the Western Illinois State Teachers College.

## Organization of Chicago Oil Burning Club

Following closely upon the organization of the American Association of Oil Burner Manufacturers, a local organization has been formed in Chicago to be known as the Chicago Oil Burning Club whose objects are stated to be "to collectively meet problems, to promote better methods in business and to enlarge mutual acquaintance." The organization meeting was held January 15 at the Virginia Hotel.

Over 100 oil burner manufacturers and their representatives and representatives of the oil industry and the allied interests were in attendance. The purpose of the meeting was set forth by Leod D. Becker, secretary of the American Association of Oil Burner Manufacturers.

Mr. Becker introduced President L. V. Nickolas, of the National Petroleum Marketers' Association, whose keynote was the future source of fuel-oil for oil burner consumption. Fuel-oil, he stated, is a by-product and is sold at by-product prices, but the time may come when fuel-oil will cease to be a by-product and it will be natural then to expect higher prices.

A discussion of Mr. Nickolas's address followed in which many took issue with his remarks and with what appeared to be a discouraging outlook for the future supply of fuel-oil. R. A. Wotowitch, of the Henry L. Doherty Company, of New York, gave a reassuring talk in which he expressed the belief that there was no cause for alarm about the future supply of fuel-oil.

Leod D. Becker was elected temporary chairman. Permanent organization was effected by the election as president of E. W. Sladkey, general sales manager of the Winslow Boiler and Engineering Co., Chicago; vice-president, Edward A. Weil, secretary-treasurer of the Automatic Burner Corporation, Chicago. Among the directors elected are Robert R. Schurig, secretary of the Chicago Steel Tank Company and B. C. Kauffman, manager of the Chicago branch of the W. S. Ray Mfg. Company, San Francisco, Cal.

A meeting was called for January 23 to prepare by-laws and to perfect and outline the purpose of the club.

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